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APPENDIX D

GEOPHYSICAL SURVEY

REF
354.
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GEI

CLEAN PROPERTIES, INC., 111 Boston Post Road, Suite 211, Sudbury, MA 01776
Phone: 978-443-6622 Fax: 781-577-1510 Email: Public@CleanProperties.com

RSI Geophysics for the 21st Century
Radar Solutions International™

March 23, 2010

Mr. Robert Houghton
Action Environmental
184 Riverview Ave, 2nd Floor
Waltham, MA 02453

Re: UST Detection Survey
515 Somerville Ave.
Somerville, Massachusetts

Dear Bob:

In accordance with your authorization, Radar Solutions International (RSI) conducted ground penetrating radar (GPR), electromagnetic (EM-61) induction and magnetic surveys at the above-referenced site on Tuesday, March 2, 2010 and Friday, March 5, 2010. RSI's Geophysicist, Ms. Melanie Denham and Geophysical Technician, Ms. Katie Dowty conducted the geophysical surveys. The purpose of the investigation was to locate possible underground storage tanks within the survey limit defined by the property boundary as shown in a plan map supplied by Action Environmental. RSI's finalized survey results and interpretations are summarized below.

LOCATION AND SURVEY CONTROL

The site is located at 515 Somerville Ave in Somerville, Massachusetts. The actual survey area was irregularly shaped, due to an irregular shaped property boundary and limited access to the outer limits, but its maximum extent was approximately 270 feet by 250 feet in size. Survey lines were extended to included as much of the area as possible within this 270 by 250 foot area, but could not include parts of the site that were inaccessible.

RSI personnel established a geophysical survey grid using fiberglass taped measurements and referenced baseline 270N to the northern most wall of an existing and abandoned building. Line 90E is coincident with the eastern portion of the wall where it intersects with line 270N. This baseline of 90E was extended the southern limit where it ended at a dirt and debris pile near 40N. The pile was inaccessible to survey and encompassed and area between 0N to 50N and from 40E to 100E. RSI's geophysical lines were oriented parallel and perpendicular to these existing building walls.

Along with the previous mentioned dirt pile, there were other obstacles and areas that were inaccessible for either one or more of the geophysical methods used. Previous UST removal took place in the area from 50E to 80E and 120N to 160N and also from 110E to 150E and 20N to 40N. There was limited GPR coverage in these areas as the terrain made it nearly impossible to keep the antenna coupled to the ground. Two large metal dumpsters were

located on site and may influence the EM-61 data. One was referenced from grid node (185E, 35N) to (175E, 60N). The second was from grid node (30E, 115N) to (42.5E, 140N). Just west of the first dumpster was a second pile of dirt and debris, located from 160E to 175E and from 35N to 55N. Covering the ground from 60N to 90N and from 225E to 250E were stacks of scrap metal and fence pieces. A small building/ shed was located from 75N to 95N and from around 245E to the fence along line 255E. Near and around grid node 170N, 100E multiple 55 gallon drums were present above ground.

A concrete slab/ foundation covered the site from 200N to 270N and 35E to 90E. This reinforced concrete was surveyed using GPR only, due to the presence of rebar. Just south of the slab was an area that had been excavated due to the presence of asbestos in the tiling. This area was not surveyed using GPR as the terrain condition was too rough, and a tarp that was covering the region had pools of water on top. EM-61 and mag were used here.

A metal chain-link fence bordered the property boundary along the north, east and south edges. In some places, due to brush and other remains, RSI was not able to access all the way to the fence. An access road/ driveway is located in westernmost portion of the site.

RSI's reference to other existing features such as monitoring wells and drain covers can been seen in the attached figures, along with the survey limits.

EM-61 lines were oriented east-west and were spaced every 2.5 feet apart. RSI collected 5 EM data points every second for total coverage of the area of investigation. GPR lines of coverage were obtained along EM-61 and along orthogonal lines spaced 5 feet apart. The location of GPR traverses and our interpreted results have been plotted on Figure 3. Figure 4 presents combined EM-61 and GPR results. Mag data was collected where the site was free from aboveground metal along lines oriented east-west. Contoured Mag results are seen on Figure 5.

METHODOLOGY

RSI used multiple geophysical techniques to best meet the objectives of Action Environmental and its client. RSI first used a GEONICS EM-61 time-domain electromagnetic instrument to detect buried metal.

This technology measures the strength of the electromagnetic field, measured in millivolts, induced within buried metal objects after the primary electromagnetic pulse has been switched off. High induced voltages indicate the presence of above or below ground metal. Induced measurements are recorded at two coils located at different heights. In the absence of any metal, the differential (i.e. the value at the top coil minus the value at the bottom coil) is zero. Positive, high-amplitude differential readings indicate that metal is likely to be present below grade. Measurements are obtained at four discrete "time-gates", after the transmitted pulse has been switched off. The larger the induced response, especially at the later time-gates, the larger metal objects.

EM-61 data were collected along lines using a line spacing of 2.5 feet. At the office, EM-61 data were transferred to a computer and contoured (i.e. data with similar values were shaded similarly to bring out patterns of high and low values). Appendix A describes the EM-61 method and its limitations in more detail.

GPR data were acquired using the GSSI SIR 3000 digital radar system with a 400 MHz antenna. The radar antenna propagates high frequency radio and microwave energy into the ground, where this energy is reflected back to the antenna by materials of differing electrical (i.e. dielectric and conductivity), and to a lesser extent, physical properties. Generally, the more conductive the soil/material and/or groundwater, the less the GPR signal penetration and resolution there is. GPR provides a pseudo cross-section wherever the antenna was moved. Possible USTs, if present, would show up as large, hyperbolic reflectors when the antenna was moved across their short axis. (The same UST would produce a flat or slightly dipping reflector when the antenna was moved parallel to the UST's long axis. GPR records would also give an indication of their approximate depth.

RSI also used a Geometrics 858 total field cesium walking magnetometer to help map iron and steel targets. The magnetic method works on the principle that ferrous (iron-steel) objects cause localized disturbances ("anomalies") in the earth's total magnetic field that are measurable with the magnetometer. Iron or steel objects may be detected to depths as great as 25 feet, depending upon the magnetic mass of the target(s) in question and the type of magnetometer used. The greater mass, the larger the disturbance recorded in the earth's field. A single metal drum buried about 4 feet below grade may produce an anomaly of 60 to 200 gammas. A single 10,000 gallon UST can produce an anomaly in the order of several thousand gammas.

RESULTS

GPR signal penetrated a maximum of 8 feet at the site, although more typically, penetration was only about 6 feet. In some areas, penetration was limited to about 4 feet, especially beneath the former building slab where there was reinforcing present. The fill appears to typically have multiple targets characteristic of "urban fill". Figures 1 and 2 summarize our EM-61 results from the differential response and third time gate. Figure 3 shows interpreted GPR data from the visual inspection of data using RADAN©, while Figure 4 shows contoured magnetic data. Figure 5 shows a combination of the EM-61 differential and GPR results. All results are presented in a scale of 1 inch equals 30 feet. Key results are presented below:

- EM-61 time gate 3 and differential results (Figures 1 and 2) shows one strong EM anomaly centered near 65E and 90N. The amplitude and shape of this anomaly suggest a larger metal target, possibly a small UST. Magnetic data (Figure 4) shows a magnetic low and magnetic high to the south of the metal target, confirming that it is iron or steel in composition. There is another magnetic low immediately south of this target. GPR data (Figure 3) indicate that there is a moderately large tank-like target coincident with the EM and magnetic anomalies. This target was observed at a depth of approximately 1 to 1.5 feet below grade, and may correspond to a small waste oil tank, oil water separator, or possibly a septic tank. GPR also indicates that there is a pipe trending to

the south, parallel to 63E to 64E toward an area previously excavated by Action Environmental.

- Numerous other GPR reflectors, both large and small targets, were observed throughout the site (Figure 3). Most do not have a corresponding EM or magnetic anomaly, suggesting that they are mostly comprised of non-metallic materials, such as concrete, brick, boulders, etc. Some may be attributed to pipes, the inferred trend of which has been plotted on Figures 3 and 5.

- Both EM-61 and magnetic data show a diffuse, large area in which above-background induced voltages and magnetic values were observed. GPR shows numerous small targets, but not any one target could account for the high EM and magnetic values observed there.

SUMMARY AND RECOMMENDATIONS

One small UST may possibly be present within the area of investigation near 64E and 90N. The target is small, but is comprised of metal, as indicated by both the EM and Magnetic data. The top of the target is only approximately 1 to 1.5 feet below grade. It is possible that this target represents a small waste oil tank, oil-water separator, or septic tank. A pipe appears to trend due south from it into an area that was previously excavated and USTs removed.

Because the nature of geophysics is interpretive, based on sometimes subjective interpretation and limitations of the data, RSI recommends that confirmatory test pits be performed at the following location:

1. 64E, 90N: possible small UST, probable metal target 1 to 1.5 feet below grade.

Action Environmental may opt for additional test pits in areas in which buried metal is indicated by both EM and magnetic data.

***

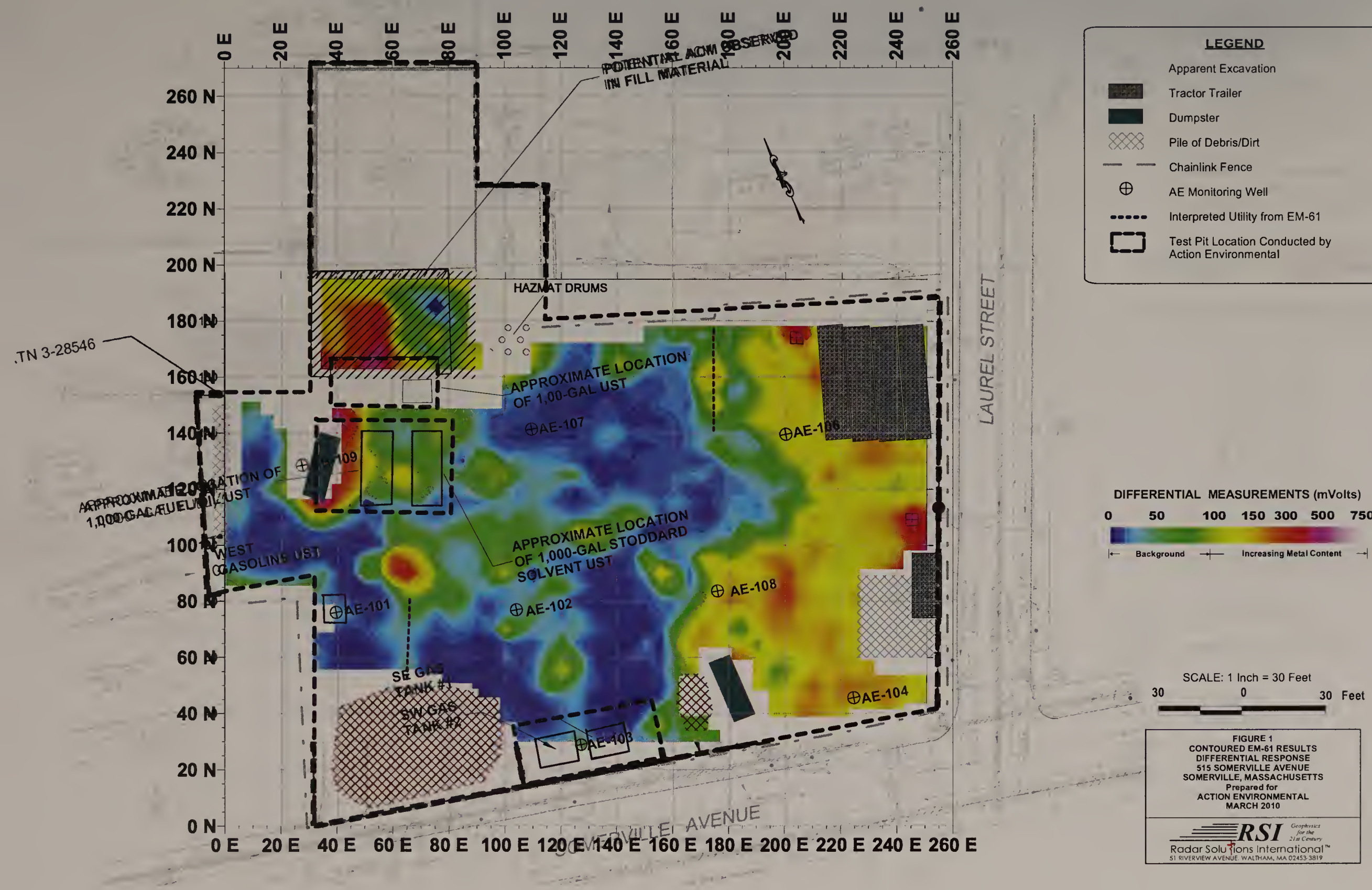
We appreciate this opportunity to work with Action Environmental. Please call should you have any inquiries regarding this or future assignments.

Sincerely,
RADAR SOLUTIONS INTERNATIONAL

Doria L Kutrubes

Doria Kutrubes, M.Sc., P.G.
President and Senior Geophysicist

51 Riverview Avenue, Waltham, MA 02453-3819
Tel. (781) 891-4492 / Fax (781) 736-0004
http://www.radar-solutions.com



LEGEND

- Apparent Excavation
- Tractor Trailer
- Dumpster
- Pile of Debris/Dirt
- Chainlink Fence
- AE Monitoring Well
- Interpreted Utility from EM-61
- Test Pit Location Conducted by Action Environmental

DIFFERENTIAL MEASUREMENTS (mVolts)

0 50 100 150 300 500 750

Background → Increasing Metal Content

SCALE: 1 Inch = 30 Feet

30 0 30 Feet

FIGURE 1
CONTOURED EM-61 RESULTS
DIFFERENTIAL RESPONSE
515 SOMERVILLE AVENUE
SOMERVILLE, MASSACHUSETTS
Prepared for
ACTION ENVIRONMENTAL
MARCH 2010

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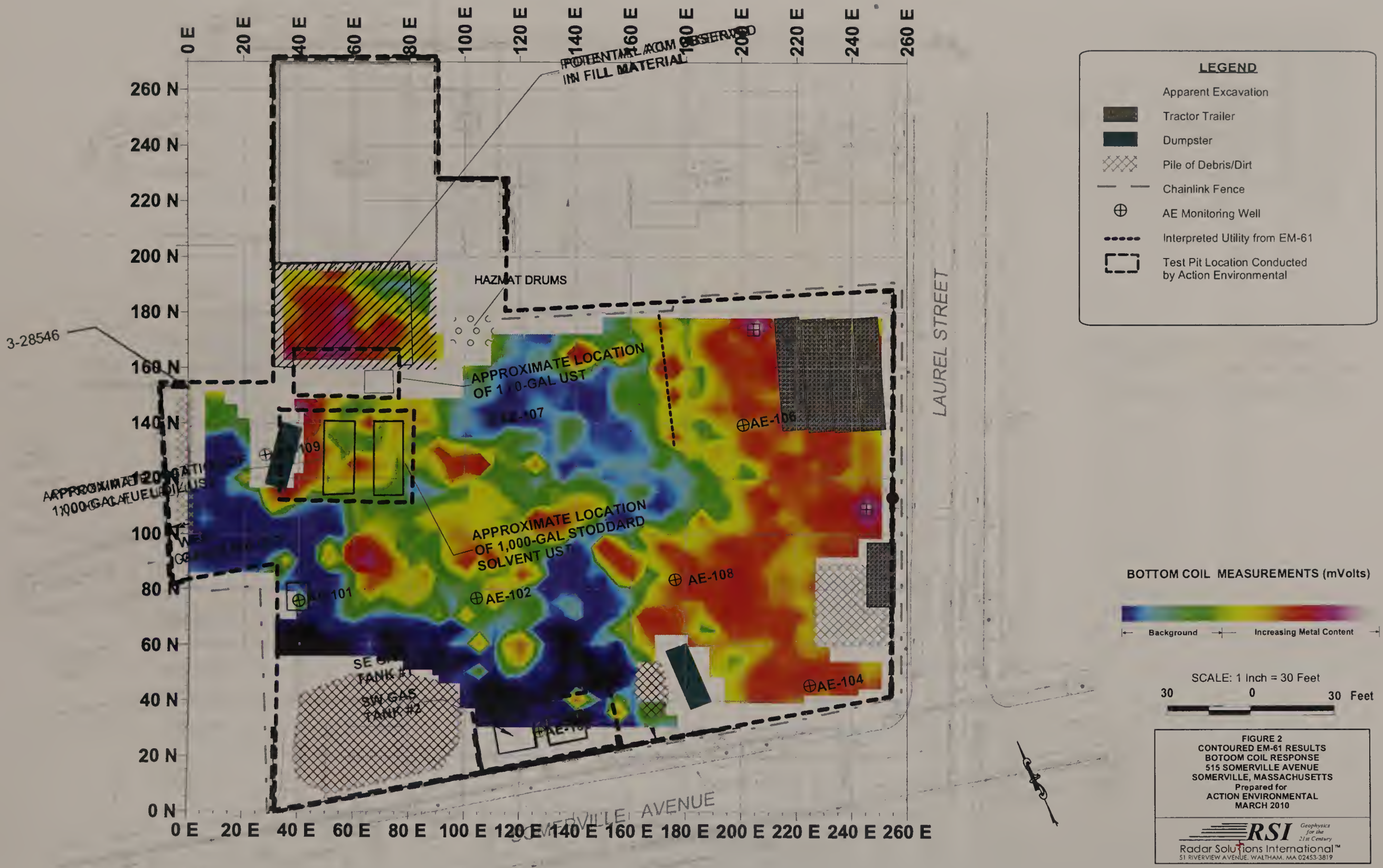

LEGEND

- Apparent Excavation
- Tractor Trailer
- Dumpster
- Pile of Debris/Dirt
- Chainlink Fence
- ⊕ AE Monitoring Well
- Interpreted Utility from EM-61
- Test Pit Location Conducted by Action Environmental

BOTTOM COIL MEASUREMENTS (mVolts)

Background ← → Increasing Metal Content

SCALE: 1 Inch = 30 Feet

30 0 30 Feet

FIGURE 2
CONTOURED EM-61 RESULTS
BOTOOM COIL RESPONSE
515 SOMERVILLE AVENUE
SOMERVILLE, MASSACHUSETTS
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MARCH 2010

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LEGEND

- Apparent Excavation
- Tractor Trailer
- Dumpster
- Pile of Debris/Dirt
- Chainlink Fence
- AE Monitoring Well
- Small, High-Amplitude GPR Reflector (probable metal scrap, cobble, possible utility); Depth (ft.) as Indicated Below
- Small, Weak-Amplitude Reflection (tentative metal scrap, concrete block or cobble, tentative utility); Depth (ft.) as Indicated Below
- Large High-Amplitude Reflector (possible UST, large diameter utility or boulder); Depth (ft.) as Indicated Below:
  - 0.0 ft. to 1.0 ft.
  - 1.0 ft. to 1.5 ft.
  - 1.5 ft. to 2.0 ft.
  - 2.0 ft. to 2.5 ft.
  - 2.5 ft. to 3.0 ft.
  - 3.0 ft. to 3.5 ft.
  - 3.5 ft. to 4.0 ft.
  - 4.0 ft. to 4.5 ft.
  - 4.5 ft. to 5.0 ft.
  - 5.0 ft. to 5.5 ft.
  - 5.5 ft. to 6.0 ft.
  - 6.0 ft. to 8.0 ft.
- Large Weak-Amplitude Reflector (possible large metal target, boulder or concrete); Depth (ft.) as Indicated Above
- Irregularly-Shaped Reflector (possible metal scrap, stratigraphpic horizon)
- Area of Attenuation
- GPR Interpreted Utility
- Recommended Test Pit Location

SCALE: 1 Inch = 30 Feet

30 0 30 Feet

FIGURE 3
INTERPRETED GPR RESULTS
515 SOMERVILLE AVENUE
SOMERVILLE, MASSACHUSETTS

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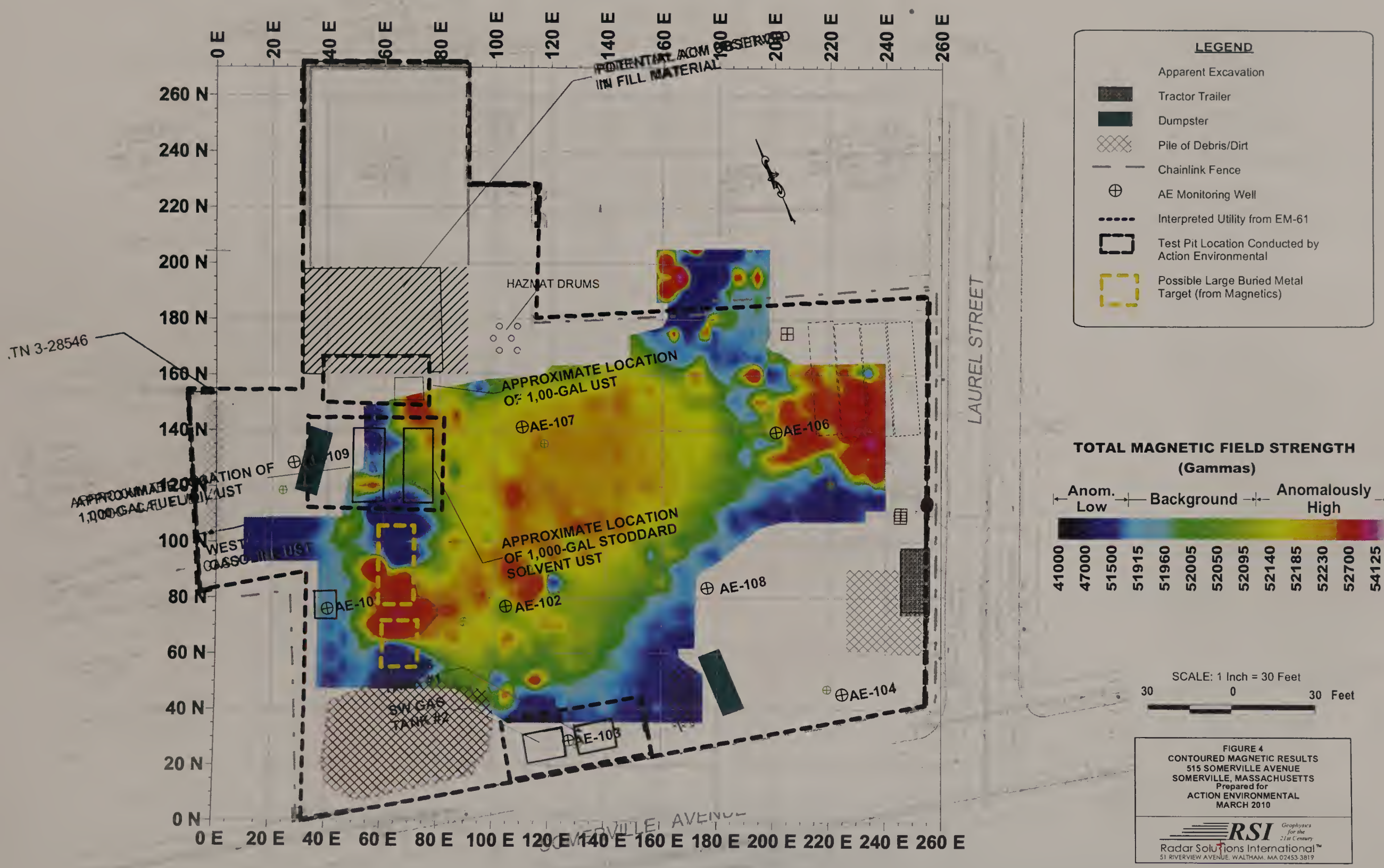

LEGEND

- Apparent Excavation
- Tractor Trailer
- Dumpster
- Pile of Debris/Dirt
- Chainlink Fence
- AE Monitoring Well
- Interpreted Utility from EM-61
- Test Pit Location Conducted by Action Environmental
- Possible Large Buried Metal Target (from Magnetics)

TOTAL MAGNETIC FIELD STRENGTH (Gammas)

Anom. Low			Background							Anomalously High	
41000	47000	51500	51915	51960	52005	52050	52095	52140	52185	52230	52700	54125

SCALE: 1 Inch = 30 Feet

30 0 30 Feet

FIGURE 4
CONTOURED MAGNETIC RESULTS
515 SOMERVILLE AVENUE
SOMERVILLE, MASSACHUSETTS
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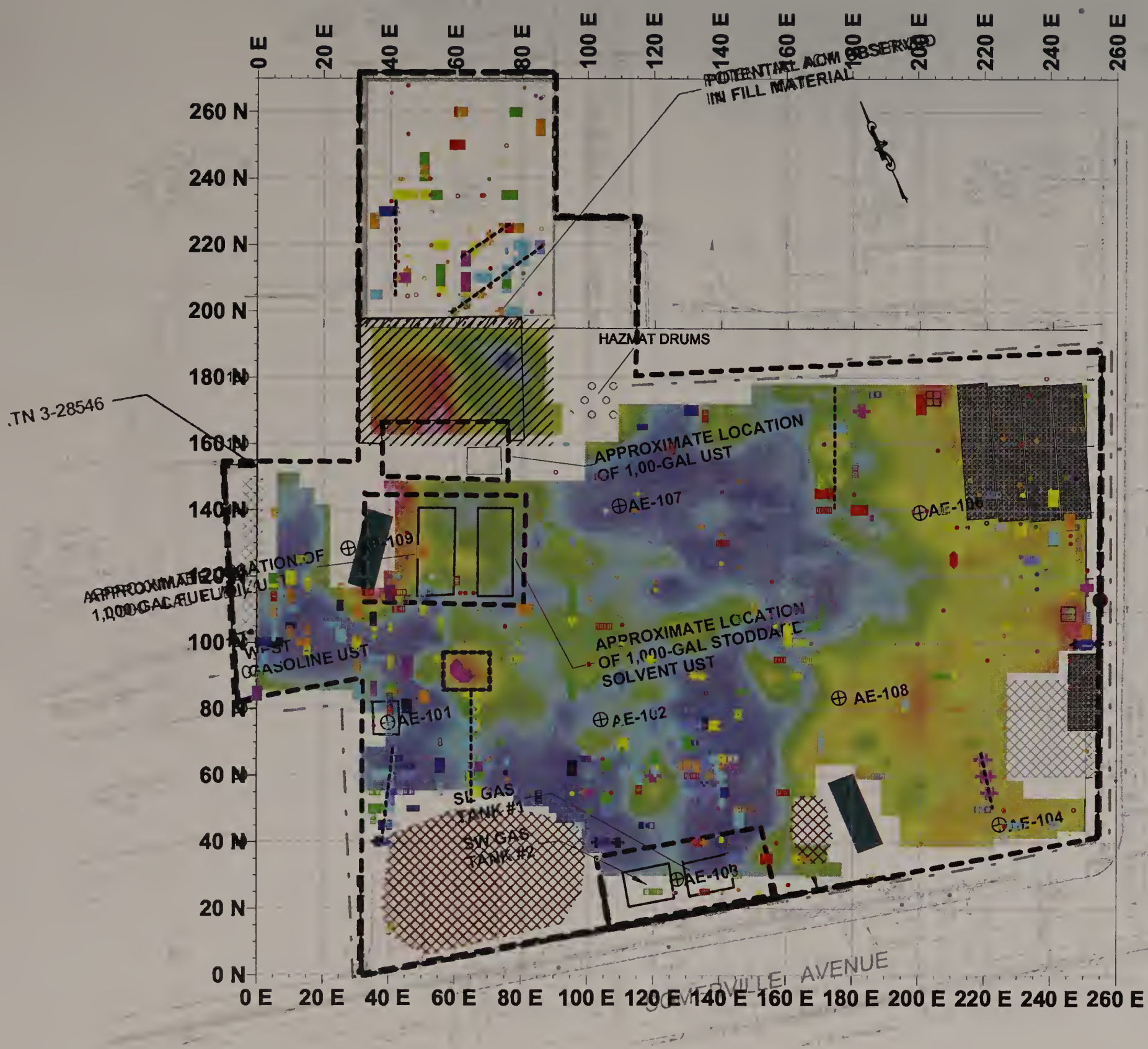

LEGEND

- Apparent Excavation
- Tractor Trailer
- Dumpster
- Pile of Debris/Dirt
- Chainlink Fence
- AE Monitoring Well
- Small, High-Amplitude GPR Reflector (probable metal scrap, cobble, possible utility); Depth (ft.) as Indicated Below
- Small, Weak-Amplitude Reflection (tentative metal scrap, concrete block or cobble, tentative utility); Depth (ft.) as Indicated Below
- Large High-Amplitude Reflector (possible UST, large diameter utility or boulder); Depth (ft.) as Indicated Below:
  - 0.0 ft. to 1.0 ft.
  - 1.0 ft. to 1.5 ft.
  - 1.5 ft. to 2.0 ft.
  - 2.0 ft. to 2.5 ft.
  - 2.5 ft. to 3.0 ft.
  - 3.0 ft. to 3.5 ft.
  - 3.5 ft. to 4.0 ft.
  - 4.0 ft. to 4.5 ft.
  - 4.5 ft. to 5.0 ft.
  - 5.0 ft. to 5.5 ft.
  - 5.5 ft. to 6.0 ft.
  - 6.0 ft. to 8.0 ft.
- Large Weak-Amplitude Reflector (possible large metal target, boulder or concrete); Depth (ft.) as Indicated Above
- Irregularly-Shaped Reflector (possible metal scrap, stratigraphpic horizon)
- Area of Attenuation
- GPR Interpreted Utility
- Recommended Test Pit Location

SCALE: 1 Inch = 30 Feet

30 0 30 Feet

FIGURE 5
COMBINED GEOPHYSICAL RESULTS
515 SOMERVILLE AVENUE
SOMERVILLE, MASSACHUSETTS

Prepared for
ACTION ENVIRONMENTAL
MARCH 2010

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APPENDIX A

EM-61 METHOD OF INVESTIGATION

Manufactured by Geonics, Inc., the EM-61 is a time-domain electromagnetic instrument developed to find unexploded ordinances (UXOs) and other buried metal targets in environments where there may be a lot of interference from surface metal and overhead power lines. According to tests conducted by the manufacturer and reports from other geophysical service providers, the EM-61 is has a sensitivity sufficient to detect metal objects as small as a few centimeters.

The EM-61 operates on the principle that the time-decay rate (i.e. transient pulse) of a signal induced in metal decays proportionally to the mass of the metal object. The EM-61 works by generating an EM signal of known frequency and voltage at the transmitter, located in the backpack configuration. In the presence of metal objects, an EM signal is induced when the transmitted signal is applied. When the transmitter is switched off, the induced field decays at a rate specific to the metal mass in which it is induced. The EM-61 top and bottom receiver coils measure the decay voltage at four specific times (i.e. "time gates") after the transmit pulse has been shut off. The amplitude of the voltage after the transmit pulse has been shut off is proportional to the size of the metal object: the larger the voltage (as measured in millivolts) at the time of the measurement, the larger the metal object. High residual voltages, especially at the later time-gates, indicate large metal objects. Negative voltages can also indicate both above-ground and buried metal.

The EM-61 operates by pulling or pushing the instrumentation along survey lines that were spaced 1 meter apart for this survey. Data can be collected using an encoder or "DMI" - distance measurement instrument, which is built into the EM-61's left wheel, or manually. The station spacing varies, depending upon the application. For this survey, data were collected using the DMI with a station spacing of 0.2 meters. Additionally, manual marks were added at a spacing of 2 meters for subsequent "rubber sheeting" of the data.

Four different data sets are generated from the two measurements made at top and bottom receiver coils: bottom, top, differential, and noise. Data obtained from the bottom receiver coil is considered to be most representative of buried and above-ground metal. Information from the top receiver coil is used with bottom coil measurements to calculate the differential data, which result from subtracting top coil measurements from bottom. Differential measurements help determine whether the source is from the above or below ground sources. Differential data are used to can also minimize the response from at or very near surface (i.e. 1 cm deep or less) metal. Positive voltages in the differential contour map shown in red, magenta, and pink, indicate buried metal. Blue or black filled contours indicate above-ground sources of metal. The "noise" calculations represent the bottom coil data that has been filtered to reduce the noise from spurious EM interference from overhead power lines, etc.

SURVEY LIMITATIONS

While differential and noise measurements help reduce EM noise from adjacent power lines, cell phone and radio towers, etc., the may not eliminate them completely. Therefore, in urban environments, data may appear noisy and not have a lot of continuity.

For maximum sensitivity, the EM-61 meter should be calibrated in an area free of buried metal and overhead power lines. Because the survey area had significant sources of cultural noise, the EM-61 instrument was not calibrated on site.

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http://www.radar-solutions.com

APPENDIX B

GROUND PENETRATING RADAR METHOD OF INVESTIGATION

A GSSI SIR 3000 radar system with a 500 megahertz (MHZ) antenna was used for the survey. GPR data were collected continuously along survey lines and displayed on a monitor. GPR data were also simultaneously recorded on a hard drive for post-survey processing. The horizontal scale on each GPR record is determined by the antenna speed. Survey stations are recorded on GPR records by pressing a marker button as the antenna's centerline passes each grid node (at 5 foot intervals for this survey). The vertical scale of these radar "cross-sections" is determined by the recording interval, which was 60 nanoseconds (ns). The recording interval represents the maximum two-way travel time in which data are recorded. This recording interval was selected to be greater than the anticipated maximum two-way travel time during which real GPR reflections might be observed. GPR travel times were converted to depths using an approximate dielectric constant determined from typical soil propagation velocities from similar sites.

The GPR method operates by transmitting low-powered microwave energy into the ground. The GPR signal is reflected back to the antenna by materials with contrasting electric (dielectric and conductive) and physical properties. Metal objects, such as USTs and pipes typically produce high-amplitude hyperbolic reflections on the GPR records. Sometimes concrete blocks, bricks, and cobbles cause similar signatures on the radar record.

SURVEY LIMITATIONS

GPR signals propagate well in sand and gravel. Conditions such as clay, ash, road salt, and fill saturated with brackish or otherwise conductive groundwater cause GPR signal attenuation and loss of target resolution (i.e. limited detection of small objects). Typically, when background conductivity measurements exceed 30 millimhos per meter (mmhos/m), GPR signal penetration is limited to 3 to 5 feet. Reinforced concrete also limits GPR penetration and resolution. Signal penetration through reinforced concrete is quite variable, ranging from approximately 1 to 5 feet depending upon the type and spacing of metal reinforcing.

GPR is an interpretive method, based on the subjective identification of reflection patterns which may not uniquely identify a subsurface target or stratigraphic horizon. For instance, the hyperbolic reflector corresponding to a utility is similar in reflection and depth characteristics to that produced by a metal scrap or cobble. Obtaining data along multiple survey traverses helps to determine the size, shape, and continuity of buried objects. For instance, buried utilities are interpreted from hyperbolic reflectors of similar depth and appearance, which are aligned along adjacent lines. Reflections from USTs are asymmetric: reflectors appear flat and of finite dimensions when the antenna moves parallel to the UST's long axis, but appear as large hyperbolic reflectors when the antenna crosses obliquely or perpendicular to the short axis of the UST. In both instances, UST reflectors are of finite length. GPR data interpretation is more subjective than that for most other geophysical methods, and confirmation using boreholes or test pits is strongly recommended.

Changes in the speed at which the antenna is moved between stations causes slight errors in horizontal distance interpolations and hence interpreted object positions.

The antenna radiation pattern is cone-shaped, emanating GPR signals approximately 15 degrees from horizontal fore and aft, and about 45 degrees from horizontal along the sides of the antenna, depending upon the dielectric properties of the soil. Therefore, buried objects may be detected before the antenna is located directly over them. Due to this effect, GPR anomalies often appear larger than actual target dimensions.

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Tel. (781) 891-4492 / Fax (781) 736-0004
http://www.radar-solutions.com

APPENDIX E

DISPOSAL DOCUMENTATION RELATIVE TO RTN 3-28545

1. Generator's US EPA ID No. MA1761652578 Manifest Document No. 62178 2. Page 1 of 1

3. Generator's Name and Mailing Address
WORLD 115 NOMINEE TRUST
PO BOX 95025
NEWTON, MA 02495
4. Generator's Phone ((617) 969-5765

A.

B. State Gen. ID
515 SOMERVILLE AVE.
SOMERVILLE MA 02143

5. Transporter 1 Company Name
CLEAN VENTURE, INC.

6. US EPA ID Number MAD982724113

C. State Trans. ID

7. Transporter 2 Company Name

8. US EPA ID Number

D. Transporter's Phone ( )

E. State Trans. ID 48279 MA

9. Designated Facility Name and Site Address
GENERAL CHEMICAL CORP.
133 LELAND STREET
FRAMINGHAM, MA 01701

10. US EPA ID Number MAD041921706

F. Transporter's Phone ( )

G. State Facility's ID NOT REQUIRED

H. Facility's Phone ((508) 872-5000

11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.	WASTE NO.
a. NON RCRA NON DOT REGULATED MATERIAL (WATER, SOIL, DEBRIS) 64431	00077		22506	G	MA99
b.					
c.					
d.					

GENERATOR

J. Additional Descriptions for Materials Listed Above (Include physical state and hazard code:)
a. c.
b. d.

K. Handling Codes for Wastes Listed Above
a. c.
b. d.

15. Special Handling Instructions and Additional Information
805071/801041/62116/16839 (1)OTH7-2 WATER, SOIL, DEBRIS
CVI Job # 356586708 24 Hour Emergency Number: (508) 872-5000

16. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to Federal Regulations for reporting proper disposal of hazardous waste.
Printed/Typed Name John Ward Signature John Ward Date 08 25 10

TRANSPORTER
17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name Mark Cronan Signature Mark Cronan Date 08 25 10
18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name Signature Date

FACILITY
19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19
Printed/Typed Name Jon Yolamini Signature Jon Yolamini Date 8 26 10

T/S/D/F COPY

1. Generator's US EPA ID No. MA617969565 62117 of 1

3. Generator's Name and Mailing Address
WORLD 115 NOMINEE TRUST
PO BOX 95025
NEWTON, MA 02495
4. Generator's Phone ((617) 969-5705

A.

B. State Gen. ID
515 SOMERVILLE AVE.
SOMERVILLE MA 02143

5. Transporter 1 Company Name
CLEAN VENTURE, INC.

6. US EPA ID Number MAR000027113

C. State Trans. ID

7. Transporter 2 Company Name

8. US EPA ID Number

D. Transporter's Phone ( )

E. State Trans. ID

9. Designated Facility Name and Site Address
GENERAL CHEMICAL CORP.
133 LELAND STREET
FRAMINGHAM, MA 01701

10. US EPA ID Number MAD981727169

F. Transporter's Phone ( )

G. State Facility's ID NOT REQUIRED

H. Facility's Phone ((508) 872-5000

11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.	I. WASTE NO.
a. NON RCRA NON DOT REGULATED MATERIAL (TRASH/DEBRIS) 64555 - 64561	XX	TOF	35000	P	MA99
b.					
c.					
d.					

GENERATOR

J. Additional Descriptions for Materials Listed Above (Include physical state and hazard code)
a. 7455
c.
b.
d.

K. Handling Codes for Wastes Listed Above
a.
c.
b.
d.

15. Special Handling Instructions and Additional Information
805071/B01041/62117/16848 (1)NSL-1 TRASH/DEBRIS 24
Hour Emergency Number: (508) 872-5000
CVI # 35658 07-08

16. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to Federal Regulations for reporting proper disposal of hazardous waste.
Printed/Typed Name John Ward Signature John Ward Date Month 08 Day 26 Year 07

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name Rick Cosette Signature Date Month 08 Day 26 Year 07

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name John Ward Signature John Ward Date Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in item 19
Printed/Typed Name Jan Talamini Signature Date Month 08 Day 27 Year 07

T/S/DF COPY

Cycle Chem, Inc.		General Chemical	Material Profile Sheet
217 South First Street Elizabeth, NJ 07206 Phone: (908) 355-5800 Fax: (908) 355-0562	550 Industrial Dr. Lewisberry, PA 17339 Phone: (717) 938-4700 Fax: (717) 938-3301	133 Leland St. Framingham. MA 01701 Phone: (508) 872-5000 Fax: (508) 875-5271	Generator Number: 805071 Product Code: OTH7-2 Sales Code: FOO

A. Generator Information

CCI/GCC Approval:

Generator Name: WORLD 115 NOMINEE TRUST — Generator USEPA ID: MP6179695705
Mailing Address: WORLD 115 NOMINEE TRUST PO BOX 95025 NEWTON, MA 02495
Site Address: WORLD 115 NOMINEE TRUST 515 SOMERVILLE AVE. SOMERVILLE, MA 02143
Generator Contact: MARK CAPPOLA — Phone # (617) 969-5705 Fax # (617) 969-5772

Billing Address: CLEAN VENTURE, INC. 138 LELAND STREET FRAMINGHAM, MA 01702
Billing Contact: _____ — Phone # (508) 872-5000 Fax # (508) 875-5271

Name of Waste: WATER, SOIL, DEBRIS — Process Generating Waste: ROLL-OFF CLEAN OUT

B. Physical Characteristics of Waste

Color/PhysicalDescription: COLOR VARIES/LIQUIDS & SLUDGES/MILD ODOR — Specific Gravity: <

Strong Incidental Odor Present?: ☐ Yes ☑ No — Wastewater?: ☐ Yes ☑ No

Physical State @ 70°:

☐ Single Phase ☑ Multilayered ☑ Solid ☐ Semi-solid ☐ Gas/Aerosol ☐ Loose Pack
☐ Bi-layered ☐ Powder ☑ Liquid ☐ Sludge ☐ Lab Pack

% Sludge _____ % Suspended solids _____ % Solid/Debris 25-100 % Free Liquids 25-25

Dumpable: ☑ Yes ☐ No — Pumpable: ☑ Yes ☐ No — Pourable: ☐ Yes ☑ No

Flashpoint: ☐ <70° ☐ 70-100° ☐ 101-141° ☐ 142-200° ☐ >200° ☑ No Flash ☐ Exact _____
Ignitable Solid: ☐ Yes ☑ No
pH: ☐ <2 ☐ 2.01-5 ☑ 5.01-9 ☐ 9.01-12.4 ☐ >12.5 ☐ Exact _____

C. Shipping Information

Quantity: 1 Units: Gallon
Price: $ _____
Container : per gal., Tanker Truck

D. Transport Information

☐ CCI/GCC to Provide Transportation
☑ Customer to Deliver to CCI/GCC
☐ Customer to Deliver to end facility Via CCI/GCC

E. Chemical Composition

Description	Range Minimum	Range Maximum
SOIL/DEBRIS/WATER	0.0%	100.0%

F. Regulatory Information

EPA Hazardous Waste?: ☐ Yes ☑ No USEPA Code(s): _____
Applicable Subcategories: _____
State Hazardous Waste?: ☐ Yes ☑ No State Code(s): MA99
D.O.T. Hazardous Waste?: ☐ Yes ☑ No Proper Shipping Name: NON RCRA NON DOT REGULATED MATERIAL (WATER, SOIL, DEBRIS)
Class: _____ I.D. NO: _____ P.G.: _____ R.Q.: _____

G. Special Handling Considerations

Project Codes:
Special Handling:
Special Handling:
Special Pricing:

H. Other Hazardous Or Infectious Characteristics

			None	Actual
☐ RCRA Reactive	☐ Water Reactive			
☐ Radioactive	☐ Subject to Subpart FF Benzene	PCB's	☑	
☐ Etiological		Cyanides	☑	
☐ TSCA Regulated	☐ Oxidizing	Phenolics	☑	
☐ Pyrophoric	☐ Explosive	Sulfides	☑	
☑ None		VOC's	☑	

☐ Is this waste characteristically hazardous (EPA Waste Codes D004-D043):
☐ Does this waste contain underlying hazardous constituents As defined In 40 CFR 268(2)(I) at at concentrations exceeding the UTS treatment standards? If yes, list In section C.

GENERATOR CERTIFICATION: I hereby certify that all information submitted in this and attached documents is complete, contains true and accurate descriptions and is representative of the waste material, and that all relevant information regarding known or suspected hazards in the possession of the Generator has been disclosed. If GCC discovers; after having taken delivery of the waste, that any waste does not conform to the identification and description On this MPS then CCI shall provide notice of such condition to the Generator and coordinate the return of the nonconforming waste to the point of origin as Set forth On the manifest or to such other locations designated In writing by the Generator. Generator agrees to reimburse CCI for all handling, packaging, clean-up and transportation costs or charges, damage to equipment, and costs associated with lost time incurred by GCC during the receipt, handling, temporary storage and return of such nonconforming waste to point of origin or to such other location designated by Generator. I hereby authorize GCC to amend and/or correct any information on the MPS with the full understanding that if any amendment or correction is performed, I will be contacted As such to issue any approval.

AUTHORIZED SIGNATURE: Mark D Cappola TITLE: Owner / Generator
DATE: 9/14/2010

Clean Venture, Inc./General Chemical Corp.
(508) 872-5000
(508) 875-5271 Fax

4701

17793

Labor - Material - Equipment
Job Sheet

Client: World Realty and Development

T & M: ☐ Contract: ☐ Lump Sum: ☐

Generator Name: Somerville, MA

Job #: 35658-07-08

Day & Date: WED 8-[redacted] 21/10

Job Location:

Site Contact:

Phone #'s:

Manifest #'s: non like
2250 gals
1 DF left onsite

S = Supervisor F = Foreman CT = Chemical Technician SO = Safety Officer
D = Driver C = Chemist EO = Equipment Operator FC = Field Clerk

Labor

Name	CODE	Start Time	Arrive @ Site	Depart Site	Finish Time	Lunch Break
Cronan	EO	6:00AM			7:00pm	1/0
Hanlon	CT	6:00AM			7:00pm	1/0
Cossette	EO					
M. Fay		11:00AM			6:00pm	

Materials

Qty.	Item	Qty.	Item
	Level C		Cubic Yard Boxes
	Level B		Flex Hose
	CSE Gear		Sorbent Pads
	Rolls of Poly		Sorbent Boom
	Poly Bags		Speedi Dry
	Duct Tape		Vermiculite
	Open Head Steel		Meters:
	Closed Head Steel	2	Chicken hawk
7x55	Open Head Poly	2	Yellow Truck
	Closed Head Poly		
	5 Gal Pails		

Equipment (4 hrs. = 1/2 day, > 4 hrs. = Full Day)

Qty.	Type	Fleet #	Hrs./ Day	Notes
	Tractor/Trailer			
	Vac (Straight)			
1	Vactor			
	Box Truck/Lift Gate			
	Roll-Off Truck			
1	Pickup/Van			
	Backhoe			
	Bobcat w/			
	Compressor w/			
	Generator			
	Roll-Off Container			
	Forklift			
	Pressure Washer			
	Pumps			
1	Hose - 6"			
	Hose - 4"			
	Hose - 3"			
	Hose - 2"			
	Misc. Hand Tools			
	Spill Trailer			

Subcontractors

Company	Description	Qty./ Hrs.

Services Performed

Vactor out roll off
load; Clean up
of solids

Work Needing Completion:

Disposal Facility:	PO #:
Arrival Time:	
Analysis Complete:	
Off-Load Time:	
Arrive Back @ Shop:	

Job Complete: Yes: ✓ No: ☐

Client:

Title: Date: 8/25/10

White - Job Folder Yellow - Payroll

Pink - Customer Green - Project Coordinator

GCC 006

Cycle Chem

The Environmental Services Source

Date 09/21/10

DISCREPANCY NOTICE

Customer:	GENERAL CHEMICAL 133-138 LELAND ST. FRAMINGHAM MA (wed)	**Work Order:**	112888
Generator:	WORLD 115 NOMINEE TRUST 515 SOMERVILLE AVENUE SOMERVILLE MA (957004)	**Date Received:**	09/09/10

Quality Control procedures performed on the above referenced waste shipment have revealed the following discrepancies with either the acceptance criteria or the Material Profile Sheet that require changing the disposal treatment or the cost.

OFF SPEC

RESPONSE REQUESTED

Waste Name:	GASOLINE	**Manifest:**	005881042JJK	**Line Item:**	Page 1 Line 1

Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]		TBD	55-G DM	TBD	2	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 11.5ppm PCBs, 9.8ppm PCB's .

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

B: Material is TSCA regulated $ TBD

[redacted]

Waste Name:	STODDARD SOLVENT	Manifest:	005881042JJK	Line Item:	Page 1 Line 3

Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]		TBD	55 G DM	TBD	1	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 19.3ppm PCBs,

PLEASE CHOOSE:

(A: Material is NOT regulated by TSCA)

B: Material is TSCA regulated $TBD

Waste Name:	STODDARD SOLVENT	Manifest:	005881042JJK	Line Item:	Page 1 Line 3

Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]	PCBT1	[redacted]	55 G DM	[redacted]	1	[redacted]

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 260.2ppm PCBs.

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

(B: Material is TSCA regulated.) ONLY BECAUSE OF PCB CONCENTRATION. 750 ppm

Total Cost Increase: [redacted] TBD

Cycle Chem will process all referenced waste streams and invoice for the listed charges If no response is received in twenty-four hours. Please authorize the above changes by signing below and faxing back to 908 355 0965 or 0562

Mark D. Cyganik — HARBISON NAMINGS TRUST — 9/22/2010

Name — Company — Date

BASED ON THE ABSENCE OF OTHER THAN TRACE CONCENTRATIONS OF PCBS IN ANY SOURCE MATERIALS TESTED AND THE ABSENCE OF PROCESSES AT THE FACILITY INVOLVING PCBs, TSCA REGULATION DOES NOT APPEAR TO BE APPLICABLE. VARIABILITY IN PCB CONTENT OVER MORE THAN AN ORDER OF MAGNITUDE SUGGESTS THE PCB CONTENT WAS DUE TO CONTRACTOR-PROVIDED CONTAMINATED DRUMS.

For ARC Use Only

GENERATOR'S WASTE PROFILE SHEET

AGGREGATE RECYCLING CORPORATION

A. Generator Information

1. GENERATOR NAME: World 115 Nominee Trust
2. SITE STREET ADDRESS: PO Box 95025
3. SITE CITY, STATE: Newton, MA 02495
4. TECHNICAL CONTACT: Duncan Wood 5. PHONE: 603-415-6162

B. Site Description

1. CURRENT SITE USAGE: Construction site, former commercial laundry and fabric cutting shop
2. PROCESS GENERATING WASTE: Removal of abandoned gasoline tanks

C. Material Description

1. CONTAMINANTS:

VIRGIN PRODUCT

XXX GASOLINE	____ # 6 FUEL OIL	____ LUBE / CUTTING OIL	
____ KEROSENE	____ MOTOR OIL	____ JP-4 / JET-A / JET FUEL	
____ DIESEL	____ HYDRAULIC FLUID	____ OTHER (EXPLAIN):	
____ # 2 FUEL OIL	____ MINERAL OIL	____	
____ # 4 FUEL OIL	____ TRANSMISSION OIL	____	

[ ] WASTE OIL

2. APPROXIMATE THE AMOUNT OF DEBRIS IN THIS MATERIAL: 10 %
ARC RETAINS THE OPTION OF CHARGING FOR DEBRIS IN EXCESS OF 15% UNLESS PREVIOUS ARRANGEMENTS ARE MADE.

3. HAS THIS SITE REMEDIATION BEEN SUPERVISED BY THE STATE OF MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION?

[ ] YES [XXX] NO

IF YES, PLEASE ATTACH SOIL SHIPMENT LETTER

4. CERTIFICATION - Please initial all appropriate sections:

[MC] I certify that, to the best of my knowledge, the waste material submitted to ARC does not contain regulated quantities of polychlorinated biphenyls, as defined by 40 CFR Part 761.

[MC] I certify that, based on knowledge of this site, the materials submitted to ARC are generated from remedial activities associated with a Petroleum Underground Storage Tank System regulated under 40 CFR Part 280. As such, this material is deferred from regulation under TCLP for Volatile and Semi-Volatile constituents.

[ ] I certify that, based on knowledge of the site, the materials submitted to ARC are generated from remedial activities involving a Petroleum Storage Tank used for the storage of heating oil for consumptive use on the premises where stored. As such, this material can be defined as "Household Waste" as defined in 40 CFR Part 261.4 (b) (1).

GENERATOR CERTIFICATION

By signing this profile sheet, the Generator certifies:

1. This waste is not a "Hazardous Waste" as defined by USEPA or State of Maine Regulations.
2. The portions of this sheet and attachments contain true and accurate descriptions of the waste material. All revelant information regarding known or suspected hazards in the possession of the Generator has been disclosed.
3. The analytical data presented herein or attached hereto were derived from testing a representative sample taken in accordance with 40 CFR 261.20(c), or equivalent rules.
4. If any changes occur in the character of the waste, the Generator shall notify ARC prior to providing the waste to ARC.

SIGNATURE: Mark Coppola TITLE: Trustee of World 115 Nominee Trust

NAME (print or type): Mark Coppola

P.O. Box 363 • Eliot, ME 03903
Phone 207-439-5584 • N.E. 800-639-7303 • Fax 207-439-5586

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012A

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number*: 3 - 23606

A. LOCATION OF SITE OR DISPOSAL SITE WHERE REMEDIATION WASTE WAS GENERATED:

Release Name (optional):

Street: 515 Somerville Avenue Location Aid:

City/Town: Somerville ZIP Code: 02143-0000

Date/Period of Generation: June 11, 2009 to: June 12,2009

Additional Release Tracking Numbers Associated with this Bill of Lading:

** Note: If this Bill of Lading is the result of a Limited Removal Action (LRA) taken prior to Notification, a Release Tracking Number is not needed.*

B. PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH BILL OF LADING:

Name of Organization: World 115 Nominee Trust

Name of Contact: Mark Coppola Title: Trustee

Street: 127A Watertown Street

City/Town: Newton State: MA ZIP Code: 02459-0000

Telephone: (617) 969-4154 Ext:

C. RELATIONSHIP TO RELEASE OF PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH BILL OF LADING:

☑ RP or PRP Specify: ☐ Owner ☐ Operator ☐ Generator ☐ Transporter ☐ Other RP or PRP: Eligible Person, defined by M.G.L. Chap. 21E, s.2

☐ Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ Other Person:

If an owner and/or operator is not conducting the response action associated with the Bill of Lading, provide on an attachment the name, contact person, address and telephone number, including any area code and extension, for each, if known.

D. TRANSPORTER OR COMMON CARRIER INFORMATION:

Transporter/Common Carrier Name: Removal Specialists

Contact Person: Shawn F. Clarke, Sr. Title: President

Street: PO Box 8069

City/Town: Lynn State: MA ZIP Code: 01904

Telephone: (781) 593-8666 Ext:

E. RECEIVING FACILITY/TEMPORARY STORAGE LOCATION:

Operator/Facility Name: Aggregate Recycling Corporation

Contact Person: John Doherty Title: CEO

Street: 434 Dow Highway

City/Town: Eliot State: ME ZIP Code: 03903

Telephone: 781-341-5500 Ext:

Type of Facility (check one): ☑ Asphalt Batch/Cold Mix ☐ Landfill/Disposal ☐ Incinerator ☐ Temporary Storage ☐ Asphalt Batch/Hot Mix ☐ Landfill/Daily Cover ☐ Other: ☐ Thermal Processing ☐ Landfill/Soil Fill

EPA Identification #:

Division of Hazardous Waste/Class A Permit #: Division of Solid Waste Management Permit #: S021815[illegible]

Actual/Anticipated Period of Temporary Storage (specify dates if applicable): to:

Reason for Temporary Storage:

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BILL OF LADING (pursuant to 310 CMR 40.0030)

BWSC-012A

Release Tracking Number: 3 - 23606

E. RECEIVING FACILITY/TEMPORARY STORAGE LOCATION (continued):

Temporary Storage Address:

Street: _____

City/Town: _____ State: _____ ZIP Code: _____

F. DESCRIPTION OF REMEDIATION WASTE:
(check all that apply)

☐ Contaminated Media (check all that apply): ○ Soil ○ Groundwater ○ Surface Water ○ Other: _____

☐ Contaminated Debris (check all that apply): ○ Vegetation or Organic Debris ○ Demolition/Construction Waste ○ Inorganic Absorbent Materials ○ Other: _____

☐ Non-hazardous Uncontainerized Waste (check all that apply): ○ Non-aqueous Phase Liquids ○ Other: _____

☑ Non-hazardous Containerized Waste (check all that apply): ◉ Tank Bottoms/Sludges ○ Containers ○ Drums ○ Engineered Impoundment ○ Other: _____

Type of Contamination (check all that apply): ☑ Gasoline ☐ Diesel Fuel ☐ #2 Oil ☐ #4 Oil ☐ #6 Oil ☐ Waste Oil ☐ Kerosene ☐ Jet Fuel ☐ Other: _____

Estimated Volume of Materials: Cubic Yards: _____ Tons: _____ Other: _____

Contaminant Source (check one/apply): ☐ Transportation Accident ☐ Underground Storage Tank ☐ Other: _____

Response Action Associated with Bill of Lading (check one): ☐ Immediate Response Action ☑ Release Abatement Measure ☐ MBTA-Related Abatement Measure ☐ Limited Removal Action ☐ Comprehensive Response Action ☐ Other _____

Remediation Waste Characterization Support Documentation attached:
☐ Site History Information ☐ Sampling and Analytical Methods and Procedures ☑ Laboratory Data ☐ Field Screening Data

If supporting documentation is not appended, provide an attachment stating the date and in connection with what document such information was previously submitted to DEP.

G. LICENSED SITE PROFESSIONAL (LSP) OPINION:

Name of Organization: Sanborn, Head & Associates, Inc.

LSP Name: Duncan W. Wood Title: Principal

Telephone: (978) 577-1019 Ext.: _____

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this submittal, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of

(i) the standard of care in 309 CMR 4.02(1),
(ii) the applicable provisions of 309 CMR 4.02(2) and (3), and
(iii) the provisions of 309 CMR 4.03(3),

to the best of my knowledge, information and belief, the assessment actions undertaken to characterize the Remediation Waste which is (are) the subject of this submittal for acceptance at the facility identified in this submittal comply with the applicable provisions of 310 CMR 40.0000, and such facility is permitted to accept Remediation Waste having the characteristics described in this submittal. I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

LSP Signature: _____ Seal:

Date: August 12, 2009

License Number: 8765

COMMONWEALTH OF MASSACHUSETTS
DUNCAN W. WOOD No. 8765 REGISTERED
LICENSED SITE PROFESSIONAL

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012A

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number*
3 - 23606

H. CERTIFICATION OF PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH THIS BILL OF LADING:

I certify under penalties of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

Signature: Mark Coppola Date: 8/12/09

Name of Person (print): Mark Coppola

Massachusetts Department of Environmental Protection BWSC-012B
Bureau of Waste Site Cleanup

BILL OF LADING (pursuant to 310 CMR 40.0030)

SUMMARY SHEET 1 OF 1

Release Tracking Number: 3-23606

I. LOAD INFORMATION:	Signature of Transporter Representative:	Receiving Facility/Temporary Storage Representative:
Load 1:		
Date of Shipment: 8-31-09	Time of Shipment: 9:01 ☒ AM ☐ PM	Date of Receipt: 8/31/09 Time of Receipt: 10:08 ☒ AM ☐ PM
Truck/Tractor Registration: #54	Trailer Registration (if any): N/A	Load Size (cu. yds./tons): 14.49
Load 2:	Signature of Transporter Representative:	Receiving Facility/Temporary Storage Representative:
Date of Shipment:	Time of Shipment: ☐ AM ☐ PM	Date of Receipt: Time of Receipt: ☐ AM ☐ PM
Truck/Tractor Registration:	Trailer Registration (if any):	Load Size (cu. yds./tons):
Load 3:	Signature of Transporter Representative:	Receiving Facility/Temporary Storage Representative:
Date of Shipment:	Time of Shipment: ☐ AM ☐ PM	Date of Receipt: Time of Receipt: ☐ AM ☐ PM
Truck/Tractor Registration:	Trailer Registration (if any):	Load Size (cu. yds./tons):
Load 4:	Signature of Transporter Representative:	Receiving Facility/Temporary Storage Representative:
Date of Shipment:	Time of Shipment: ☐ AM ☐ PM	Date of Receipt: Time of Receipt: ☐ AM ☐ PM
Truck/Tractor Registration:	Trailer Registration (if any):	Load Size (cu. yds./tons):
Load 5:	Signature of Transporter Representative:	Receiving Facility/Temporary Storage Representative:
Date of Shipment:	Time of Shipment: ☐ AM ☐ PM	Date of Receipt: Time of Receipt: ☐ AM ☐ PM
Truck/Tractor Registration:	Trailer Registration (if any):	Load Size (cu. yds./tons):
Load 6:	Signature of Transporter Representative:	Receiving Facility/Temporary Storage Representative:
Date of Shipment:	Time of Shipment: ☐ AM ☐ PM	Date of Receipt: Time of Receipt: ☐ AM ☐ PM
Truck/Tractor Registration:	Trailer Registration (if any):	Load Size (cu. yds./tons):

J. LOG SHEET VOLUME INFORMATION:	
Total Volume Recorded This Page (cu. yds./tons):	14.49
Total Carried Forward (cu. yds./tons):	-0-
Total Carried Forward and This Page (cu. yds./tons):	14.49

Revised 10/3/94

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012C

BILL OF LADING (pursuant to 310 CMR 40.0030)

SUMMARY SHEET 1 OF 1

Release Tracking Number: 3 - 23606

K. SUMMARY OF SHIPMENTS:

Date of Shipment:	Date of Receipt:	Number of Loads Shipped:	Daily Volume Shipped (cu. yds. or tons):
8/31/09	8/31/09	1	14.49

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012C

BILL OF LADING (pursuant to 310 CMR 40.0030)

SUMMARY SHEET

Release Tracking Number: 3 - 23606

ONLY COMPLETE ONE COPY OF THIS PAGE AND ATTACH TO THE FINAL COPY OF THE SUMMARY SHEET.

L. ACKNOWLEDGMENT OF RECEIPT OF REMEDIATION WASTE AT RECEIVING FACILITY OR TEMPORARY STORAGE:

Receiving Facility/Temporary Storage Representative (print): John J. Doherty Title: CEO

Signature: John J. Doherty Date: 8-31-09

M. ACKNOWLEDGMENT OF SHIPMENT AND RECEIPT OF REMEDIATION WASTE BY PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH THIS BILL OF LADING:

I certify under penalties of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

Signature: _____ Date: _____

Name of Person (print): Mark Coppola

AGGREGATE RECYCLING CORP
434 DOW HIGHWAY
PO BOX 363
ELIOT, ME 03903

Ticket No # 90756
Date :08/31/2009
Phone :(207)439-5584
Fax :(207)439-5586

Custoeer:29-08-09
WORLD 115 NOMINEE TRUST
PO BOX 95025

NEWTON MA, 02495

REM 54

SOIL SOIL

Gross: 66520 lb Scale In 10:12
Tare: 37540 lb Scale Out 10:24
Net: 28980 lb
14.490 tn

Weigh Master: ROD

Driver:

Remarks:

Material $	0.00
Delivery $	0.00
Misc $	0.00
Tax $	0.00
Total $	0.

File Copy original mailed to Duncan on 9-14-09.

Cycle Chem

The Environmental Services Source

Date 09/21/10

DISCREPANCY NOTICE

Customer:	GENERAL CHEMICAL 133-139 LELAND ST. FRAMINGHAM MA (wsd)	Work Order:	112866
Generator:	WORLD 115 NOMINEE TRUST 515 SOMERVILLE AVENUE SOMERVILLE MA (957004)	Date Received:	09/09/10

Quality Control procedures performed on the above referenced waste shipment have revealed the following discrepancies with either the acceptance criteria or the Material Profile Sheet that require changing the disposal treatment or the cost.

OFF SPEC

RESPONSE REQUESTED

Waste Name:	GASOLINE		Manifest:	009961042JJK		Line Item:	Page 1 Line 1
Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]		TBD	55-G DM	TBD	2	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 11.8ppm PCBs, 8.8ppm PCB's .

PLEASE CHOOSE:

(A: Material is NOT regulated by TSCA)

B: Material is TSCA regulated $ TBD

Waste Name:	STODDARD SOLVENT	Manifest:	005691042JJK	Line Item:	Page 1 Line 3		
Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]		TBD	55 G DM	TBD	1	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 19.3ppm PCBs.

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

B: Material is TSCA regulated $TBD

Waste Name:	STODDARD SOLVENT	Manifest:	005691042JJK	Line Item:	Page 1 Line 5		
Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]	PCBT1	[redacted]	55 G DM	[redacted]	1	[redacted]

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 288.2ppm PCBs.

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

B: Material is TSCA regulated. ONLY BECAUSE OF PCB CONCENTRATION. 750 ppm

Total Cost Increase: [redacted] 785

Cycle Chem will process all referenced waste streams and invoice for the listed changes. If no response is received in twenty-four hours, Please authorize the above changes by signing below and faxing back to 908 325 0905 or [redacted]

Mark J. Cyganik — Mid Atlantic Trust — 9/22/2010

Name — Company — Date

BASED ON THE ABSENCE OF OTHER THAN TRACE CONCENTRATIONS OF PCB IN ANY SOURCE MATERIALS TESTED AND THE ABSENCE OF PROCESSES AT THE FACILITY HANDLING PCB, TSCA REGULATION DOES NOT APPEAR TO BE APPLICABLE. VARIABILITY IN PCB CONTENT OVER MORE THAN AN ORDER OF MAGNITUDE SUGGESTS THE PCB CONTENT WAS DUE TO CONTRACTOR-PROVIDED CONTAMINATED DRUMS.

SOMERVILLE FIRE DEPARTMENT FIRE PREVENTION BUREAU

[redacted]

ADDRESS # 519 ADDRESS Somerville Ave

OWNER Gus Service Station

OWNER ADDRESS

OWNER CITY.TOWN

OWNER STATE.ZIP MA

OWNER TEL#

BUSINESS NAME

BUSINESS TEL#

PERMIT #

USAGE

OCCUPANCY

UNDERGROUND TANKS INSTALLED

Install Date	#	Size	Product

UNDERGROUND TANKS REMOVED

Remove Date	#	Size	Product
11-23-81	1	4000	Gasoline
	2	2000	Gasoline
08-21-82	1	500	Heat Oil
08-21-89	1	500	Waste Oil
07-13-90	1	2000	Gasoline
	2	4000	Gasoline

COMMENTS

SOMERVILLE FIRE DEPARTMENT FIRE PREVENTION BUREAU

HAZARDOUS SPILLS / LEAKS

DRESS # 519 ADDRESS Somerville Ave

OWNER	Gus Service Station	BUSINESS NAME	
OWNER ADDRESS		BUSINESS TEL#	
OWNER CITY.TOWN		TYPE OF INCIDENT	
OWNER STATE.ZIP	MA	INCIDENT #	
OWNER TEL#		DATE	Oct 15, 90

COMMENTS

Waiver site. First listed LTBI 10/15/90, First listed confirmed 10/15/90, Waiver approved date 06/28/90, Completion statement received ?/?/?.

UNDERGROUND TANK SURVEY

November 5, 2002

TO: Rizzo Associates
1 Grant Street
Framingham, MA 01701

Attn: Jennifer L. DeAscentis

RE: 21 E for 515-519 Somerville Avenue

The below information reflects the records of the Somerville Fire Department relative to underground tanks installed or removed within the City of Somerville which we hope will assist you in 21E survey.

You are advised that the Somerville Fire Department is providing this information "to the best of our knowledge" and bears no burden for: "infallible records" for which you are passing on this information to your client.

See attached printouts for :

21 E for 515-519 Somerville Avenue

Abutters and locations nearest to:

21 E for 515-519 Somerville Avenue

For records of spills or leaks of flammable or hazardous materials, see attached printouts.

Information found for this report: As Follows

Respectfully,

James Hodnett
Deputy Chief
Fire Prevention Bureau

SOMERVILLE FIRE DEPARTMENT FIRE PREVENTION BUREAU

[redacted]

ADDRESS # 515 ADDRESS Somerville Ave

OWNER Sal Barterna

OWNER ADDRESS 6 Pickard Lane

OWNER CITY.TOWN North Reading

OWNER STATE.ZIP MA. 01864

OWNER TEL# 978-664-4411

BUSINESS NAME John Solomon Inc.

BUSINESS TEL# 617-666-4411

PERMIT #

USAGE Clothing Manufacturing

OCCUPANCY

UNDERGROUND TANKS INSTALLED

Install Date	#	Size	Product
9-22-52	1	10,000	Solvent
9-22-52	1	10,000	Heat
9-22-52	1	500	Gasoline

UNDERGROUND TANKS REMOVED

Remove Date	#	Size	Product	Inst Date

COMMENTS

2002- discovered that 3 tanks were located at this site. File shows that tanks have not been removed.

SOMERVILLE FIRE DEPARTMENT FIRE PREVENTION BUREAU

[redacted]

ADDRESS # 519 ADDRESS Somerville Ave

OWNER Jim DeVellis

OWNER ADDRESS

OWNER CITY.TOWN

OWNER STATE.ZIP MA

OWNER TEL#

BUSINESS NAME Massive Video

BUSINESS TEL# 617-625-4211

PERMIT #

USAGE

OCCUPANCY

UNDERGROUND TANKS INSTALLED

Install Date	#	Size	Product

UNDERGROUND TANKS REMOVED

Remove Date	#	Size	Product	Inst Date
11-23-81	1	4000	Gasoline	
	2	2000	Gasoline	
08-21-82	1	500	Heat Oil	
08-21-89	1	500	Waste Oil	
07-13-90	1	2000	Gasoline	
	2	4000	Gasoline	

COMMENTS

NAME AND ADDRESS OF APPROVED TANK YARD: JOHN C. TOMMARELLO & SONS, 207 MARSTON ST. LAWRENCE, MASS. 01841

APPROVED TANK YARD NO. 1 4 9 0 1

Tank Yard Ledger 502 CMR 3.03(4) Number: 9 0 0 1 2 4 5

I certify under penalty of law I have personally examined the underground steel storage tank delivered to this "approved tank yard" by firm, corporation or partnership SUFFOLK SERVICES and accepted same in conformance with Massachusetts Fire Prevention Regulation 502 CMR 3.00 Provisions for Approving Underground Steel Storage Tank dismantling yards. A valid permit was issued by LOCAL Head of Fire Department FDID# 12274 to transport this tank to this yard.

Name and official title of approved tank yard owner or owners authorized representative:

James Masanto	CPW	7-13-90
SIGNATURE	TITLE	DATE SIGNED

This signed receipt of disposal must be returned to the local head of the fire department FDID# 12274 pursuant to 502 CMR 3:00. (EACH TANK MUST HAVE A RECEIPT OF DISPOSAL)

FORM F.P. 291 (rev. 9/88) (OVER) MASSACHUSETTS STATE FIRE MARSHAL'S OFF.

RECEIPT OF DISPOSAL OF UNDERGROUND STEEL STORAGE TANK

NAME AND ADDRESS OF APPROVED TANK YARD: JOHN C. TOMMARELLO & SONS, 207 MARSTON ST. LAWRENCE, MASS. 01841

APPROVED TANK YARD NO. 1 4 9 0 1

Tank Yard Ledger 502 CMR 3.03(4) Number: 9 0 0 1 2 4 7

I certify under penalty of law I have personally examined the underground steel storage tank delivered to this "approved tank yard" by firm, corporation or partnership SUFFOLK SERVICES and accepted same in conformance with Massachusetts Fire Prevention Regulation 502 CMR 3.00 Provisions for Approving Underground Steel Storage Tank dismantling yards. A valid permit was issued by LOCAL Head of Fire Department FDID# 12274 to transport this tank to this yard.

Name and official title of approved tank yard owner or owners authorized representative:

James Masanto	CPW	7-13-90
SIGNATURE	TITLE	DATE SIGNED

This signed receipt of disposal must be returned to the local head of the fire department FDID# 12274 pursuant to 502 CMR 3:00. (EACH TANK MUST HAVE A RECEIPT OF DISPOSAL)

FORM F.P. 291 (rev. 9/88) (OVER) MASSACHUSETTS STATE FIRE MARSHAL'S OFFI

RECEIPT OF DISPOSAL OF UNDERGROUND STEEL STORAGE TANK

NAME AND ADDRESS OF APPROVED TANK YARD: JOHN C. TOMMARELLO & SONS, 207 MARSTON ST. LAWRENCE, MASS. 01841

APPROVED TANK YARD NO. 1 4 9 0 1

Tank Yard Ledger 502 CMR 3.03(4) Number: 9 0 0 1 2 4 6

I certify under penalty of law I have personally examined the underground steel storage tank delivered to this "approved tank yard" by firm, corporation or partnership SUFFOLK SERVICES and accepted same in conformance with Massachusetts Fire Prevention Regulation 502 CMR 3.00 Provisions for Approving Underground Steel Storage Tank dismantling yards. A valid permit was issued by LOCAL Head of Fire Department FDID# 12274 to transport this tank to this yard.

Name and official title of approved tank yard owner or owners authorized representative:

James Masanto	CPW	7-13-90
SIGNATURE	TITLE	DATE SIGNED

This signed receipt of disposal must be returned to the local head of the fire department FDID# 12274 pursuant to 502 CMR 3:00. (EACH TANK MUST HAVE A RECEIPT OF DISPOSAL)

FORM F.P. 291 (rev. 9/88) (OVER) MASSACHUSETTS STATE FIRE MARSHAL'S OFFIC

DIMENSIONS

	Width		Length
Tank 1	64"	X	23'11'
Tank 2	-----	X	-----
Tank 3	-----	X	-----
Tank 4	-----	X	-----
Tank 5	-----	X	-----
	(feet)		(feet)

Tank Removed From
519 Somerville Ave. (Gus's Service Station)
(no. street)
Somerville
(city or town)

Fire Department Permit # none-listed
(if applicable)

DIMENSIONS

	Width		Length
Tank 1	64"	X	12'1"
Tank 2	-----	X	-----
Tank 3	-----	X	-----
Tank 4	-----	X	-----
Tank 5	-----	X	-----
	(feet)		(feet)

Tank Removed From
519 Somerville Ave (Gus's Service Station)
(no. street)
Somerville
(city or town)

Fire Department Permit # none-listed
(if applicable)

DIMENSIONS

	Width		Length
Tank 1	64"	X	23'11"
Tank 2	-----	X	-----
Tank 3	-----	X	-----
Tank 4	-----	X	-----
Tank 5	-----	X	-----
	(feet)		(feet)

Tank Removed From
519 Somerville Ave. (Gus's Service Station)
(no. street)
Somerville
(city or town)

Fire Department Permit # none-listed
(if applicable)

GASOLINE STATION INSPECTION

Location: 519 Somerville AVE Self-Service: Y N Date: 3/18/8;

Business Name: Gus's Service Center Phone #: 623-9068

Trade Name of product being dispensed: CITGO GAS

Owner: Gus Ficosi Home Phone # 666-1899

address: 19 Sartwell Ave Zip #

UNDERGROUND TANKS

list by size, number total: 4-4000 gallons, 4000 gallons, 2000 gallons
waste oil: 500 gallons

observation wells: —, none

NOTES:

PUMPS/DISPENSERS

Total pumps/dispensers: 4 Self-serve type: Y (N)
(circle type) (note, no lever-holders allowed)

Nozzle examination: UL listed: (Y) N Condition: (Pass) Fail Replace # _____ nozzle

Hose Examination: (Pass) Fail Replace # _____ hose

Test for product leak: visual evidence of leakage: Y (N)
(remove pump covers)

Flow test of product: pass fail: _____ seconds delay. Pump # _____

Daily inventory records: current not up to date not on premises

last date of entry

GENERAL INSPECTION

All Licenses posted: (Y) N Licenses granted: Garage ✓
NOTE: Garage license is part of license to dispense gasoline at retail, for general repairs only. Used Car
Parking
Junk

Portable Extinguishers: Type; A-B-C, CO-2, Other B-C Current insp. tags (Y) N
(note: minimum of two 10 pound A-B-C, mounted on wall)

Signs posted at pump island: (Y) N Notes:
("no smoking", "turn off motor")

General Housekeeping: EXCELLENT, [redacted] (POOR) VERY POOR, Comments:

Waste oil burner: Brand name: NONE Model # _____ Mass. Cert. Y N

Exterior Inspection: EXCELLENT, (GOOD,) POOR, VERY POOR, Comments:

Build-up of old tires/batteries: Y (N) Inspector: Capt. Hurley

[redacted]

YEARLY MAINTENANCE PERMITS
FOR
ABOVE GROUND STORAGE, UNDERGROUND STORAGE, FLAMMABLE STORAGE, GARAGE

ADDRESS: 515 Somerville Ave **BUS:** Clothing Manufacturing

NAME: John Solomon Inc. DIST: 4

FOR THE FOLLOWING		ISSUED	EXPIRES
ABOVE GROUND STORAGE MAINT PERMIT #:	FEE $:		
UNDERGROUND STORAGE MAINT PERMIT #:	FEE $:		
(NOT LICENSED) FLAMMABLE PERMIT #: F-006	FEE $: 25	06/01/02	06/30/03
GARAGE MAIN PERMIT #:	FEE $:		
LUMBER YARD #:	FEE $:		

LICENSE RESTRICTIONS

1. 4.
2. 5.
3. 6.

ABOVE GROUND RESTRICTIONS

1. 3. 5.
2. 4. 6.

UNDERGROUND RESTRICTIONS

1. 3. 5.
2. 4. 6.

FLAMMABLE RESTRICTIONS

1. 3- 5 Gal Buckets Alcohol 4. To be stored in Flam Storage Room 7.
2. 3- 5 Gal Buckets Shellac 5. To be stored in Flam Storage Room 8.
3. Assorted Spray Paints 6. To be storage in Flam Storage Room 9.

GARAGE PERMIT RESTRICTIONS

1. 2. 3.

OWNER INFORMATION	TENANT INFORMATION
Name: Sal Barterna	Name:
Address: 6 Pickard Lane	Address:
City.Town: North Reading	City.Town:
State.Zip: MA. 01864	State.Zip:
Tel: 978-664-4411	Tel:
Bus Phone: 617-666-4411 Fax 617-666-9944	Business Phone:
Person to Fax To: Mike Espinola (plant engineer)	Contact Person: Heruan Jansen
Contact Person Tel 603-893-0390	Contact Person Tel: 469-1864

Other: This system monitored by Congress Alarm 617-323-6413.

f/u sent letter
/Processed

[redacted]

YEARLY MAINTENANCE PERMITS
FOR
ABOVE GROUND STORAGE, UNDERGROUND STORAGE, FLAMMABLE STORAGE, GARAGE

ADDRESS: 515 Somerville Ave **BUS:** Clothing Manufacturing

NAME: John Solomon Inc. DIST: 4

FOR THE FOLLOWING		ISSUED	EXPIRES
ABOVE GROUND STORAGE MAINT PERMIT #:	FEE $:		
UNDERGROUND STORAGE MAINT PERMIT #:	FEE $:		
(NOT LICENSED) FLAMMABLE PERMIT #: F-006	FEE $: 25	06/01/01	06/30/02
GARAGE MAIN PERMIT #:	FEE $:		
LUMBER YARD #:	FEE $:		

LICENSE RESTRICTIONS

1.
2.
3.
4.
5.
6.

ABOVE GROUND RESTRICTIONS

1.
2.
3.
4.
5.
6.

UNDERGROUND RESTRICTIONS

1.
2.
3.
4.
5.
6.

FLAMMABLE RESTRICTIONS

1. 3- 5 Gal Buckets Alcohol
2. 3- 5 Gal Buckets Shellac
3. Assorted Spray Paints
4. To be stored in Flam Storage Room
5. To be stored in Flam Storage Room
6. To be storage in Flam Storage Room
7.
8.
9.

GARAGE PERMIT RESTRICTIONS

1.
2.
3.

OWNER INFORMATION	TENANT INFORMATION
Name: Sal Barterna	Name:
Address: 6 Pickard Lane	Address:
City.Town: North Reading	City.Town:
State.Zip: MA. 01864	State.Zip:
Tel: 978-664-4411	Tel:
Bus Phone: 617-666-4411 Fax 617-666-9944	Business Phone:
Person to Fax To: Mike Espinola (plant engineer)	~~Contact Person:~~ Heruan Jansen
Contact Person Tel 603-893-0390	Contact Person Tel: 469-1864

Other: This system monitored by Congress Alarm 617-323-6413.

Jm 8/01

M.A.C.

[redacted]

YEARLY MAINTENANCE PERMITS
FOR
ABOVE GROUND STORAGE, UNDERGROUND STORAGE, FLAMMABLE STORAGE, GARAGE

ADDRESS: 515 Somerville Ave **BUS:** Clothing Manufacturing

NAME: John Solomon Inc. DIST: 4

FOR THE FOLLOWING		ISSUED	EXPIRES
ABOVE GROUND STORAGE MAINT PERMIT #:	FEE $:		
UNDERGROUND STORAGE MAINT PERMIT #:	FEE $:		
(NOT LICENSED) FLAMMABLE PERMIT #:	FEE $:	06/01/03	06/30/04
GARAGE MAIN PERMIT #:	FEE $:		
LUMBER YARD OR MISC. PERMIT #:	FEE $:		

LICENSE & MISC. PERMIT RESTRICTIONS

1.
2.
3.
4. **NOTE: TIER II REPORTER SEE CHIEF GRANEY**
5.
6.

ABOVE GROUND RESTRICTIONS

1. 3. 5.
2. 4. 6.

UNDERGROUND RESTRICTIONS

1. 2-10,000 Gallons **ABANDONED** 3. 5.
2. 1- 500 Gallons **ABANDONED** 4. 6.

FLAMMABLE RESTRICTIONS

1. 3- 5 Gal Buckets Alcohol
2. 3- 5 Gal Buckets Shellac
3. Assorted Spray Paints
4. To be stored in Flam Storage Room
5. To be stored in Flam Storage Room
6. To be storage in Flam Storage Room
7.
8.
9.

GARAGE PERMIT RESTRICTIONS

1. 2. 3.

OWNER INFORMATION	TENANT INFORMATION
Name: Sal Barterna	Name: Dave Johanson
Address: 6 Pickard Lane	Address:
City.Town: North Reading	City.Town:
State.Zip: MA. 01864	State.Zip:
Tel: 978-664-4411	Tel:
Bus Phone: 617-666-4411 Fax 617-666-9944	Business Phone:
Person to Fax To: Mike Espinola (plant engineer)	Contact Person: Heruan Jansen
Contact Person Tel 603-893-0390	Contact Person Tel: 469-1864

Other: This system monitored by Congress Alarm 617-323-6413.
O.O.B. 2003

SOMERVILLE FIRE DEPARTMENT FIRE PREVENTION BUREAU

[redacted]

ADDRESS # 515 ADDRESS Somerville Ave

OWNER Sal Barterna

OWNER ADDRESS 6 Pickard Lane

OWNER CITY.TOWN North Reading

OWNER STATE.ZIP MA. 01864

OWNER TEL# 978-664-4411

BUSINESS NAME John Solomon Inc.

BUSINESS TEL# 617-666-4411

PERMIT #

USAGE Clothing Manufacturing

OCCUPANCY

UNDERGROUND TANKS INSTALLED

Install Date	#	Size	Product
9-22-52	1	10,000	Solvent
9-22-52	1	10,000	Heat
9-22-52	1	500	Gasoline

UNDERGROUND TANKS REMOVED

Remove Date	#	Size	Product	Inst Date

COMMENTS

2002- discovered that 3 tanks were located at this site. File shows that tanks have not been removed.

SOMERVILLE FIRE DEPARTMENT
FIRE PREVENTION BUREAU

PUBLIC SAFETY BUILDING
255 SOMERVILLE AVENUE
SOMERVILLE MASSACHUSETTS 02143

TEL.: (617) 623-1700
FAX: (617) 666-4597

Mr. Eamon McGilligan
Executive Director
Somerville Planning Board
February 3 , 2005

Dear Sir.

The following is an addendum to the comments the Bureau submitted on 2/2/05.

515 Somerville Avenue - There are three (3) underground fuel tanks on this site. They will have to be removed before any construction can take place at this site. Permits will be required for the removals. In addition the removals will have to take place under Fire Prevention supervision. See the enclosed documentation.

If there are any questions you can reach me at ext. 8400.

Yours . Truly

Deputy Chief
Fire Prevention

SOMERVILLE FIRE DEPARTMENT
FIRE PREVENTION BUREAU

PUBLIC SAFETY BUILDING
255 SOMERVILLE AVENUE
SOMERVILLE, MASSACHUSETTS 02143

TEL.: (617) 623-1700
FAX: (617) 666-4597

March 25, 2009

To;Chief Kelleher
From:Deputy Chief Steve Keenan
Re:Situation at 515 Somerville Ave

Dear Chief;

I want to give you a brief report on this site(formerly Solomon Company).There is a proposal to build a combination of residential and commercial units in several buildings at this site.

At the meeting at DPW on 3-19-09 it was brought to their attention by a representative from DEP and Mr. Willette that they had not acted in a timely manner to address environmental issues such as asbestos removal and the removal of soil,etc..

They are under a tight deadline to rectify these issues. Until they meet their obligations It appears they will not get a building permit. I"ll keep you updated as best as possible, but these developers have a lot to do with little time to spare.

Respectfully submitted,

Deputy Chief Steve Keenan

Steve Keenan
Deputy Chief
Fire Prevention

APPENDIX F

DISPOSAL DOCUMENTS RELATIVE TO RTN 3-28546

1. Generator's US EPA ID No. MA6215765585 Manifest Document No. 62 VX 8 2. Page 1 of 1

3. Generator's Name and Mailing Address
WORLD 115 NORINEE TRUST
PO BOX 95025
NEWTON, MA 02495
4. Generator's Phone ((617) 969-5785

A.

B. State Gen. ID
515 SOMERVILLE AVE.
SOMERVILLE MA 02143

5. Transporter 1 Company Name: CLEAN VENTURE, INC.
6. US EPA ID Number: MAD981121116

C. State Trans. ID

7. Transporter 2 Company Name
8. US EPA ID Number

D. Transporter's Phone ( )

E. State Trans. ID 40279 MA

9. Designated Facility Name and Site Address
GENERAL CHEMICAL CORP.
133 LELAND STREET
FRAMINGHAM, MA 01701
10. US EPA ID Number: MAD981121116

F. Transporter's Phone ( )

G. State Facility's ID NOT REQUIRED

H. Facility's Phone ((508) 872-5000

11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	12. Containers No.	Type	13. Total Quantity	Unit Wt/Vol	WASTE NO.
a. NON RCRA NON DOT REGULATED MATERIAL (WATER, SOIL, DEBRIS) 64431	00	TT	2210	G	MA99
b.					
c.					
d.					

GENERATOR

J. Additional Descriptions for Materials Listed Above (Include physical state and hazard code.)
a.
c.
b.
d.

K. Handling Codes for Wastes Listed Above
a.
c.
b.
d.

15. Special Handling Instructions and Additional Information
805071/B01041/62116/16839 (1)OTH7-2 WATER, SOIL, DEBRIS
CVI Job # 3565806708 24 Hour Emergency Number: (508) 872-5000

16. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to Federal Regulations for reporting proper disposal of hazardous waste.
Printed/Typed Name: John Ward Signature: John Ward Date: Month 08 Day 25 Year 10

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: Mark Cronan Signature: Mark Cronan Date: Month 08 Day 25 Year 10

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name Signature Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name: Jon Tylamini Signature: Jon Tylamini Date: Month 08 Day 26 Year 10

T/S/D/F COPY

1. Generator's US EPA ID No. MP617961965 | 62117 | of 1

3. Generator's Name and Mailing Address
WORLD 115 NOMINEE TRUST
PO BOX 95825
NEWTON, MA 02495
4. Generator's Phone ((617) 969-5705

A.

B. State Gen. ID
515 SOMERVILLE AVE.
SOMERVILLE MA 02143

5. Transporter 1 Company Name
CLEAN VENTURE, INC.

6. US EPA ID Number
MAD981271213

C. State Trans. ID

7. Transporter 2 Company Name

8. US EPA ID Number

D. Transporter's Phone ( )

E. State Trans. ID

9. Designated Facility Name and Site Address
GENERAL CHEMICAL CORP.
133 LELAND STREET
FRAMINGHAM, MA 01701

10. US EPA ID Number
MAD981371879

F. Transporter's Phone ( )

G. State Facility's ID NOT REQUIRED

H. Facility's Phone (508) 872-5000

11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.	I. WASTE NO.
a. NON RCRA NON DOT REGULATED MATERIAL (TRASH/DEBRIS) 64555 - 64561	XX	7DF	3500	P	MA99
b.					
c.					
d.					

GENERATOR

J. Additional Descriptions for Materials Listed Above (Include physical state and hazard code)
a. 7455
c.
b.
d.

K. Handling Codes for Wastes Listed Above
a.
c.
b.
d.

15. Special Handling Instructions and Additional Information
805971/801041/62117/16848 (1)NSL-1 TRASH/DEBRIS 24
Hour Emergency Number: (508) 872-5000
CVI # 35658 07-08

16. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to Federal Regulations for reporting proper disposal of hazardous waste.
Printed/Typed Name Joe Ward Signature John Ward Date Month 08 Day 26 Year 17

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name Rick Gosette Signature Date Month 08 Day 26 Year 17

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name John Ward Signature Date Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in item 19
Printed/Typed Name Jon Talamini Signature Date Month 08 Day 27 Year 17

T/S/D/F COPY

Cycle Chem, Inc.		General Chemical	Material Profile Sheet
217 South First Street Elizabeth, NJ 07206 Phone: (908) 355-5800 Fax: (908) 355-0562	550 Industrial Dr. Lewisberry, PA 17339 Phone: (717) 938-4700 Fax: (717) 938-3301	133 Leland St. Framingham. MA 01701 Phone: (508) 872-5000 Fax: (508) 875-5271	Generator Number: 805071 Product Code: OTH7-2 Sales Code: FOO

A. Generator Information

CCI/GCC Approval:

Generator Name: WORLD 115 NOMINEE TRUST — Generator USEPA ID: MP6179695705
Mailing Address: WORLD 115 NOMINEE TRUST PO BOX 95025 NEWTON, MA 02495
Site Address: WORLD 115 NOMINEE TRUST 515 SOMERVILLE AVE. SOMERVILLE, MA 02143
Generator Contact: MARK CAPPOLA — Phone # (617) 969-5705 Fax # (617) 969-5772

Billing Address: CLEAN VENTURE, INC. 138 LELAND STREET FRAMINGHAM, MA 01702
Billing Contact: _____ — Phone # (508) 872-5000 Fax # (508) 875-5271

Name of Waste: WATER, SOIL, DEBRIS — Process Generating Waste: ROLL-OFF CLEAN OUT

B. Physical Characteristics of Waste

Color/PhysicalDescription: COLOR VARIES/LIQUIDS & SLUDGES/MILD ODOR — Specific Gravity: <

Strong Incidental Odor Present?: ☐ Yes ☑ No — Wastewater?: ☐ Yes ☑ No

Physical State @ 70°:
☐ Single Phase ☑ Multilayered ☑ Solid ☐ Semi-solid ☐ Gas/Aerosol ☐ Loose Pack
☐ Bi-layered ☐ Powder ☑ Liquid ☐ Sludge ☐ Lab Pack

% Sludge _____ % Suspended solids _____ % Solid/Debris 25-100 % Free Liquids 25-25

Dumpable: ☑ Yes ☐ No — Pumpable: ☑ Yes ☐ No — Pourable: ☐ Yes ☑ No

Flashpoint: ☐ <70° ☐ 70-100° ☐ 101-141° ☐ 142-200° ☐ >200° ☑ No Flash ☐ Exact _____
Ignitable Solid: ☐ Yes ☑ No
pH: ☐ <2 ☐ 2.01-5 ☑ 5.01-9 ☐ 9.01-12.4 ☐ >12.5 ☐ Exact _____

C. Shipping Information

Quantity: 1 — Units: Gallon
Price: $
Container : per gal., Tanker Truck

D. Transport Information

☐ CCI/GCC to Provide Transportation
☑ Customer to Deliver to CCI/GCC
☐ Customer to Deliver to end facility Via CCI/GCC

E. Chemical Composition

Description	Range Minimum	Range Maximum
SOIL/DEBRIS/WATER	0.0%	100.0%

F. Regulatory Information

EPA Hazardous Waste?: ☐ Yes ☑ No — USEPA Code(s): _____
Applicable Subcategories: _____
State Hazardous Waste?: ☐ Yes ☑ No — State Code(s): MA99
D.O.T. Hazardous Waste?: ☐ Yes ☑ No — Proper Shipping Name: NON RCRA NON DOT REGULATED MATERIAL (WATER, SOIL, DEBRIS)
Class: _____ — I.D. NO: _____ — P.G.: _____ — R.Q.: _____

G. Special Handling Considerations

Project Codes:
Special Handling:
Special Handling:
Special Pricing:

H. Other Hazardous Or Infectious Characteristics

			None	Actual
☐ RCRA Reactive	☐ Water Reactive			
☐ Radioactive	☐ Subject to Subpart	PCB's	☑	_____
☐ Etiological	FF Benzene	Cyanides	☑	_____
☐ TSCA Regulated	☐ Oxidizing	Phenolics	☑	_____
☐ Pyrophoric	☐ Explosive	Sulfides	☑	_____
☑ None		VOC's	☑	_____

☐ Is this waste characteristically hazardous (EPA Waste Codes D004-D043):
☐ Does this waste contain underlying hazardous constituents As defined In 40 CFR 268(2)(I) at at concentrations exceeding the UTS treatment standards? If yes, list In section C.

GENERATOR CERTIFICATION: I hereby certify that all information submitted in this and attached documents is complete, contains true and accurate descriptions and is representative of the waste material, and that all relevant information regarding known or suspected hazards in the possession of the Generator has been disclosed. If GCC discovers; after having taken delivery of the waste, that any waste does not conform to the identification and description On this MPS then CCI shall provide notice of such condition to the Generator and coordinate the return of the nonconforming waste to the point of origin as Set forth On the manifest or to such other locations designated in writing by the Generator. Generator agrees to reimburse CCI for all handling, packaging, clean-up and transportation costs or charges, damage to equipment, and costs associated with lost time incurred by GCC during the receipt, handling, temporary storage and return of such nonconforming waste to point of origin or to such other location designated by Generator. I hereby authorize GCC to amend and/or correct any information on the MPS with the full understanding that if any amendment or correction is performed, I will be contacted As such to issue my approval.

AUTHORIZED SIGNATURE: Mark D Cappola — TITLE: Owner / Generator
DATE: 9/14/2010

Clean Venture, Inc./General Chemical Corp.
(508) 872-5000
(508) 875-6271 Fax

4701

17793

Labor - Material - Equipment
Job Sheet

Client: World Realty and Development

T & M: ☐ Contract: ☐ Lump Sum: ☐

Generator Name: Somerville, MA

Job #: 35658-07-08

Day & Date: WED 8-[redacted] 21/10

Job Location:

Manifest #'s: non haz
2250 gals
1 DF left onsite

Site Contact:

Phone #'s:

S = Supervisor F = Foreman CT = Chemical Technician SO = Safety Officer
D = Driver C = Chemist EO = Equipment Operator FC = Field Clerk

Labor

Name	CODE	Start Time	Arrive @ Site	Depart Site	Finish Time	Lunch Break
Cronan	EO	6:00am			7:00pm	1/0
Hanlon	CT	6:00AM			7:00pm	0
Gossette	EO					
M. Fay		11:00am			6:00pm	

Materials

Qty.	Item	Qty.	Item
	Level C		Cubic Yard Boxes
	Level B		Flex Hose
	CSE Gear		Sorbent Pads
	Rolls of Poly		Sorbent Boom
	Poly Bags		Speedi Dry
	Duct Tape		Vermiculite
	Open Head Steel		Meters:
	Closed Head Steel	2	Chicken Hawk
7x55	Open Head Poly	2	Yellow Truck
	Closed Head Poly		
	5 Gal Pails		

Equipment (4 hrs. = 1/2 day, > 4 hrs. = Full Day)

Qty.	Type	Fleet #	Hrs./ Day	Notes
	Tractor/Trailer			
	Vac (Straight)			
1	Vactor			
	Box Truck/Lift Gate			
	Roll-Off Truck			
1	Pickup/Van			
	Backhoe			
	Bobcat w/			
	Compressor w/			
	Generator			
	Roll-Off Container			
	Forklift			
	Pressure Washer			
	Pumps			
1	Hose - 6"			
	Hose - 4"			
	Hose - 3"			
	Hose - 2"			
	Misc. Hand Tools			
	Spill Trailer			

Subcontractors

Company	Description	Qty./ Hrs.

Services Performed

Vactor out roll off
tank; clean up
of solids

Work Needing Completion:

Disposal Facility:	PO #:
Arrival Time:	
Analysis Complete:	
Off-Load Time:	
Arrive Back @ Shop:	

Job Complete: Yes: ☑ No: ☐

Client:

Title: Date: 8/25/10

White - Job Folder Yellow - Payroll Pink - Customer Green - Project Coordinator

GCC 006

Cycle Chem

The Environmental Services Source

Date 09/21/10

DISCREPANCY NOTICE

Customer:	GENERAL CHEMICAL 133-138 LELAND ST. FRAMINGHAM MA (wsd)	**Work Order:**	112888
Generator:	WORLD 115 NOMINEE TRUST 515 SOMERVILLE AVENUE SOMERVILLE MA (957004)	**Date Received:**	09/09/10

Quality Control procedures performed on the above referenced waste shipment have revealed the following discrepancies with either the acceptance criteria or the Material Profile Sheet that require changing the disposal treatment or the cost.

OFF SPEC

RESPONSE REQUESTED

Waste Name:	GASOLINE			**Manifest:**	005881042JJK		**Line Item:**	Page 1 Line 1
Product Code	**Price**	**New Product Code**	**New Price**	**Drum Size**	**Cost Increase**	**Quantity**	**Total**	
IK	[redacted]		TBD	55-G DM	TBD	2	TBD	

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 11.5ppm PCBs, 9.8ppm PCB's .

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

B: Material is TSCA regulated $ TBD

[redacted]

Waste Name:	STODDARD SOLVENT	Manifest:	005881042JJK	Line Item:	Page 1 Line 3

Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]		TBD	55 G DM	TBD	1	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 19.3ppm PCBs,

PLEASE CHOOSE:

(A: Material is NOT regulated by TSCA)

B: Material is TSCA regulated $TBD

Waste Name:	STODDARD SOLVENT	Manifest:	005881042JJK	Line Item:	Page 1 Line 3

Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]	PCBT1	[redacted]	55 G DM	[redacted]	1	[redacted]

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 260.2ppm PCBs.

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

(B: Material is TSCA regulated.) ONLY BECAUSE OF PCB CONCENTRATION. 750 ppm

Total Cost Increase: [redacted] TBD

Cycle Chem will process all referenced waste streams and invoice for the listed charges If no response is received in twenty-four hours. Please authorize the above changes by signing below and faxing back to 908 355 0955 or 0562

Mark D. Cappelli — WASTE MANAGEMENT TRUST — 9/22/2010

Name — Company — Date

BASED ON THE ABSENCE OF OTHER THAN TRACE CONCENTRATIONS OF PCB IN ANY SOURCE MATERIALS TESTED AND THE ABSENCE OF PROCESSES AT THE FACILITY INVOLVING PCBs, TSCA REGULATION DOES NOT APPEAR TO BE APPLICABLE. VARIABILITY IN PCB CONTENT OVER MORE THAN AN ORDER OF MAGNITUDE SUGGESTS THE PCB CONTENT WAS DUE TO CONTRACTOR-PROVIDED CONTAMINATED DRUMS.

Cycle Chem

The Environmental Services Source

Date 09/21/10

DISCREPANCY NOTICE

Customer:	GENERAL CHEMICAL 133-138 LELAND ST. FRAMINGHAM MA (wed)	**Work Order:**	112888
Generator:	WORLD 115 NOMINEE TRUST 515 SOMERVILLE AVENUE SOMERVILLE MA (957004)	**Date Received:**	09/09/10

Quality Control procedures performed on the above referenced waste shipment have revealed the following discrepancies with either the acceptance criteria or the Material Profile Sheet that require changing the disposal treatment or the cost.

OFF SPEC

RESPONSE REQUESTED

Waste Name:	GASOLINE		**Manifest:**	005881042JJK		**Line Item:**	Page 1 Line 1
Product Code	**Price**	**New Product Code**	**New Price**	**Drum Size**	**Cost Increase**	**Quantity**	**Total**
IK	[redacted]		TBD	55 G DM	TBD	2	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 11.5ppm PCBs, 9.8ppm PCB's .

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

B: Material is TSCA regulated $ TBD

Waste Name:	STODDARD SOLVENT		Manifest:	005881042JJK		Line Item:	Page 1 Line 3
Product Code	**Price**	**New Product Code**	**New Price**	**Drum Size**	**Cost Increase**	**Quantity**	**Total**
IK	[redacted]		TBD	55 G DM	TBD	1	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 19.3ppm PCBs,

PLEASE CHOOSE:

(A: Material is NOT regulated by TSCA)

B: Material is TSCA regulated $TBD

Waste Name:	STODDARD SOLVENT		Manifest:	005881042JJK		Line Item:	Page 1 Line 3
Product Code	**Price**	**New Product Code**	**New Price**	**Drum Size**	**Cost Increase**	**Quantity**	**Total**
IK	[redacted]	PCBT1	[redacted]	55 G DM	[redacted]	1	[redacted]

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 260.2ppm PCBs.

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

(B: Material is TSCA regulated.) ONLY BECAUSE OF PCB CONCENTRATION. 750 ppm

Total Cost Increase: [redacted] TBD

Cycle Chem will process all referenced waste streams and invoice for the listed charges if no response is received in twenty-four hours. Please authorize the above changes by signing below and faxing back to 908 355 0965 or 0562

William J. Cassell — WORLD WIDE NOMINEE TRUST — 9/22/2010

Name — Company — Date

BASED ON THE ABSENCE OF OTHER THAN TRACE CONCENTRATIONS OF PCBs IN ANY SOURCE MATERIALS TESTED AND THE ABSENCE OF PROCESSES AT THE FACILITY INVOLVING PCBs, TSCA REGULATION DOES NOT APPEAR TO BE APPLICABLE. VARIABILITY IN PCB CONTENT OVER MORE THAN AN ORDER OF MAGNITUDE SUGGESTS THE PCB CONTENT WAS DUE TO CONTRACTOR-PROVIDED CONTAMINATED DRUMS.

Figure No. 2

IRA PLAN

SITE PLAN

515 SOMERVILLE AVENUE

SOMERVILLE, MASSACHUSETTS

Drawn By: RWH
Designed By: JTR
Reviewed By: DWW
Date: SEP 09

Figure Narrative

The base map was drawn from a plan entitled "SITE PLAN" and was prepared by Design Consultants, Inc. of Somerville, Massachusetts and dated May 25, 2007 with an original scale of 1" = 20'.

This plan shows the approximate locations of 4 Release Tracking Numbers (RTNs) located at the 515 Somerville Avenue property

PROJECT NO.: 2315.03

GRAPHICAL SCALE

0 20 40 60 FEET

SHA

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ALPHA ANALYTICAL

ANALYTICAL REPORT

Lab Number:	L0907777
Client:	Sanborn, Head & Associates, Inc. 1 Technology Park Drive Westford, MA 01886
ATTN:	Duncan Wood
Project Name:	515 SOMERVILLE AVE
Project Number:	2315.03
Report Date:	06/22/09

Certifications & Approvals: MA (M-MA086), NY NELAC (11148), CT (PH-0574), NH (2003), NJ (MA935), RI (LAO00065), ME (MA0086), PA (Registration #68-03671), USDA (Permit #S-72578), US Army Corps of Engineers, Naval FESC.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

ALPHA ANALYTICAL

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L0907777-01	NORTH TANK SOLIDS	SOMERVILLE, MA	06/12/09 13:55
L0907777-02	SOUTHERN GAS TANK SOLIDS	SOMERVILLE, MA	06/12/09 13:35

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

MADEP MCP Response Action Analytical Report Certification

This form provides certifications for all samples performed by MCP methods. Please refer to the Sample Results and Container Information sections of this report for specification of MCP methods used for each analysis. The following questions pertain only to MCP Analytical Methods.

An affirmative response to questions A, B, C & D is required for "Presumptive Certainty" status		
A	Were all samples received by the laboratory in a condition consistent with those described on their Chain-of-Custody documentation for the data set?	YES
B	Were all QA/QC procedures required for the specified analytical methods(s) included in this report followed, including the requirement to note and discuss in a narrative QC data that did not meet appropriate performance standards or guidelines?	YES
C	Does the analytical data included in this report meet all the requirements for "Presumptive Certainty", as described in section 2.0 of the MADEP document CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	YES
D	VPH and EPH methods only: Was the VPH or EPH method run without significant modifications, as specified in Section 11.3?	N/A
A response to questions E and F is required for "Presumptive Certainty" status		
E	Were all QC performance standards and recommendations for the specified method(s) achieved?	NO
F	Were results for all analyte-list compounds/elements for the specified method(s) reported?	NO

For any questions answered "No", please refer to the case narrative section on the following page(s).

Please note that sample matrix information is located in the Sample Results section of this report.

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

MCP Related Narratives

Volatile Organics

L0907777-01 has elevated detection limits due to the dilution required by the elevated concentrations of target compounds in the sample.

In reference to question E:

The WG367369-1/-2 LCS/LCSD recoveries associated with L0907777-01 and -02 are outside the acceptance criteria for several compounds; however, they have been identified as "difficult" analytes. The results of the associated samples are reported; however, all results are considered to have a potentially high bias for

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Case Narrative (continued)

Bromomethane (LCS at 134%) and a potentially low bias for Dichlorodifluoromethane (66%/64%).

Metals

In reference to question F:

All samples were analyzed for a subset of MCP elements per the Chain of Custody.

Mercury

L0907777-01 was re-analyzed on a dilution for Mercury in order to quantitate the sample within the calibration range. The result should be considered estimated, and is qualified with an E flag, for the compound that exceeded the calibration on the initial analysis. The re-analysis was performed only for the compound that exceeded the calibration range.

Non-MCP Related Narratives

Petroleum Hydrocarbons

L0907777-01 has elevated detection limits due to the dilution required by the matrix interferences encountered during the concentration of the sample and the dilution required by the elevated concentrations of target compounds in the sample.

The surrogate recovery for L0907777-01 was below the acceptance criteria for o-Terphenyl (0%) due to the dilutions required to quantitate the sample. Re-extraction is not required; therefore, the results of the original analysis are reported.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Elizabeth A Simmons

Title: Technical Director/Representative

Date: 06/22/09

ORGANICS

VOLATILES

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-01
Client ID: NORTH TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil
Analytical Method: 60,8260B
Analytical Date: 06/18/09 09:47
Analyst: BN
Percent Solids: 63%

Date Collected: 06/12/09 13:55
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Volatile Organics by 8260B/5035 - Westborough Lab					
Methylene chloride	ND		ug/kg	740000	500
1,1-Dichloroethane	ND		ug/kg	110000	500
Chloroform	ND		ug/kg	110000	500
Carbon tetrachloride	ND		ug/kg	74000	500
1,2-Dichloropropane	ND		ug/kg	260000	500
Dibromochloromethane	ND		ug/kg	74000	500
1,1,2-Trichloroethane	ND		ug/kg	110000	500
Tetrachloroethene	ND		ug/kg	74000	500
Chlorobenzene	ND		ug/kg	74000	500
Trichlorofluoromethane	ND		ug/kg	370000	500
1,2-Dichloroethane	ND		ug/kg	74000	500
1,1,1-Trichloroethane	ND		ug/kg	74000	500
Bromodichloromethane	ND		ug/kg	74000	500
trans-1,3-Dichloropropene	ND		ug/kg	74000	500
cis-1,3-Dichloropropene	ND		ug/kg	74000	500
1,1-Dichloropropene	ND		ug/kg	370000	500
Bromoform	ND		ug/kg	300000	500
1,1,2,2-Tetrachloroethane	ND		ug/kg	74000	500
Benzene	ND		ug/kg	74000	500
Toluene	ND		ug/kg	110000	500
Ethylbenzene	130000		ug/kg	74000	500
Chloromethane	ND		ug/kg	370000	500
Bromomethane	ND		ug/kg	150000	500
Vinyl chloride	ND		ug/kg	150000	500
Chloroethane	ND		ug/kg	150000	500
1,1-Dichloroethene	ND		ug/kg	74000	500
trans-1,2-Dichloroethene	ND		ug/kg	110000	500
Trichloroethene	ND		ug/kg	74000	500
1,2-Dichlorobenzene	ND		ug/kg	370000	500
1,3-Dichlorobenzene	ND		ug/kg	370000	500

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-01
Client ID: NORTH TANK SOLIDS
Sample Location: SOMERVILLE, MA

Date Collected: 06/12/09 13:55
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Volatile Organics by 8260B/5035 - Westborough Lab					
1,4-Dichlorobenzene	ND		ug/kg	370000	500
Methyl tert butyl ether	ND		ug/kg	150000	500
p/m-Xylene	880000		ug/kg	150000	500
o-Xylene	580000		ug/kg	150000	500
cis-1,2-Dichloroethene	ND		ug/kg	74000	500
Dibromomethane	ND		ug/kg	740000	500
1,2,3-Trichloropropane	ND		ug/kg	740000	500
Styrene	ND		ug/kg	150000	500
Dichlorodifluoromethane	ND		ug/kg	740000	500
Acetone	ND		ug/kg	740000	500
Carbon disulfide	ND		ug/kg	3700000	500
2-Butanone	ND		ug/kg	740000	500
4-Methyl-2-pentanone	ND		ug/kg	740000	500
2-Hexanone	ND		ug/kg	740000	500
Bromochloromethane	ND		ug/kg	370000	500
Tetrahydrofuran	ND		ug/kg	1500000	500
2,2-Dichloropropane	ND		ug/kg	370000	500
1,2-Dibromoethane	ND		ug/kg	300000	500
1,3-Dichloropropane	ND		ug/kg	370000	500
1,1,1,2-Tetrachloroethane	ND		ug/kg	74000	500
Bromobenzene	ND		ug/kg	370000	500
n-Butylbenzene	440000		ug/kg	74000	500
sec-Butylbenzene	290000		ug/kg	74000	500
tert-Butylbenzene	ND		ug/kg	370000	500
o-Chlorotoluene	ND		ug/kg	370000	500
p-Chlorotoluene	ND		ug/kg	370000	500
1,2-Dibromo-3-chloropropane	ND		ug/kg	370000	500
Hexachlorobutadiene	ND		ug/kg	370000	500
Isopropylbenzene	160000		ug/kg	74000	500
p-Isopropyltoluene	350000		ug/kg	74000	500
Naphthalene	ND		ug/kg	370000	500
n-Propylbenzene	510000		ug/kg	74000	500
1,2,3-Trichlorobenzene	ND		ug/kg	370000	500
1,2,4-Trichlorobenzene	ND		ug/kg	370000	500
1,3,5-Trimethylbenzene	1800000		ug/kg	370000	500
1,2,4-Trimethylbenzene	5100000		ug/kg	370000	500
Ethyl ether	ND		ug/kg	370000	500

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-01
Client ID: NORTH TANK SOLIDS
Sample Location: SOMERVILLE, MA

Date Collected: 06/12/09 13:55
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Volatile Organics by 8260B/5035 - Westborough Lab					
Isopropyl Ether	ND		ug/kg	300000	500
Ethyl-Tert-Butyl-Ether	ND		ug/kg	300000	500
Tertiary-Amyl Methyl Ether	ND		ug/kg	300000	500
1,4-Dioxane	ND		ug/kg	37000000	500

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	92		70-130
Toluene-d8	108		70-130
4-Bromofluorobenzene	111		70-130
Dibromofluoromethane	89		70-130

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-02
Client ID: SOUTHERN GAS TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil
Analytical Method: 60,8260B
Analytical Date: 06/18/09 10:22
Analyst: BN
Percent Solids: 92%

Date Collected: 06/12/09 13:35
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Volatile Organics by 8260B/5035 - Westborough Lab					
Methylene chloride	ND		ug/kg	680	1
1,1-Dichloroethane	ND		ug/kg	100	1
Chloroform	ND		ug/kg	100	1
Carbon tetrachloride	ND		ug/kg	68	1
1,2-Dichloropropane	ND		ug/kg	240	1
Dibromochloromethane	ND		ug/kg	68	1
1,1,2-Trichloroethane	ND		ug/kg	100	1
Tetrachloroethene	ND		ug/kg	68	1
Chlorobenzene	ND		ug/kg	68	1
Trichlorofluoromethane	ND		ug/kg	340	1
1,2-Dichloroethane	140		ug/kg	68	1
1,1,1-Trichloroethane	ND		ug/kg	68	1
Bromodichloromethane	ND		ug/kg	68	1
trans-1,3-Dichloropropene	ND		ug/kg	68	1
cis-1,3-Dichloropropene	ND		ug/kg	68	1
1,1-Dichloropropene	ND		ug/kg	340	1
Bromoform	ND		ug/kg	270	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	68	1
Benzene	1200		ug/kg	68	1
Toluene	5600		ug/kg	100	1
Ethylbenzene	1500		ug/kg	68	1
Chloromethane	ND		ug/kg	340	1
Bromomethane	ND		ug/kg	140	1
Vinyl chloride	ND		ug/kg	140	1
Chloroethane	ND		ug/kg	140	1
1,1-Dichloroethene	ND		ug/kg	68	1
trans-1,2-Dichloroethene	ND		ug/kg	100	1
Trichloroethene	ND		ug/kg	68	1
1,2-Dichlorobenzene	ND		ug/kg	340	1
1,3-Dichlorobenzene	ND		ug/kg	340	1

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-02
Client ID: SOUTHERN GAS TANK SOLIDS
Sample Location: SOMERVILLE, MA

Date Collected: 06/12/09 13:35
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Volatile Organics by 8260B/5035 - Westborough Lab					
1,4-Dichlorobenzene	ND		ug/kg	340	1
Methyl tert butyl ether	ND		ug/kg	140	1
p/m-Xylene	6200		ug/kg	140	1
o-Xylene	2600		ug/kg	140	1
cis-1,2-Dichloroethene	ND		ug/kg	68	1
Dibromomethane	ND		ug/kg	680	1
1,2,3-Trichloropropane	ND		ug/kg	680	1
Styrene	ND		ug/kg	140	1
Dichlorodifluoromethane	ND		ug/kg	680	1
Acetone	ND		ug/kg	680	1
Carbon disulfide	ND		ug/kg	3400	1
2-Butanone	ND		ug/kg	680	1
4-Methyl-2-pentanone	ND		ug/kg	680	1
2-Hexanone	ND		ug/kg	680	1
Bromochloromethane	ND		ug/kg	340	1
Tetrahydrofuran	ND		ug/kg	1400	1
2,2-Dichloropropane	ND		ug/kg	340	1
1,2-Dibromoethane	ND		ug/kg	270	1
1,3-Dichloropropane	ND		ug/kg	340	1
1,1,1,2-Tetrachloroethane	ND		ug/kg	68	1
Bromobenzene	ND		ug/kg	340	1
n-Butylbenzene	320		ug/kg	68	1
sec-Butylbenzene	99		ug/kg	68	1
tert-Butylbenzene	ND		ug/kg	340	1
o-Chlorotoluene	ND		ug/kg	340	1
p-Chlorotoluene	ND		ug/kg	340	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	340	1
Hexachlorobutadiene	ND		ug/kg	340	1
Isopropylbenzene	200		ug/kg	68	1
p-Isopropyltoluene	100		ug/kg	68	1
Naphthalene	780		ug/kg	340	1
n-Propylbenzene	440		ug/kg	68	1
1,2,3-Trichlorobenzene	ND		ug/kg	340	1
1,2,4-Trichlorobenzene	ND		ug/kg	340	1
1,3,5-Trimethylbenzene	1100		ug/kg	340	1
1,2,4-Trimethylbenzene	3000		ug/kg	340	1
Ethyl ether	ND		ug/kg	340	1

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-02
Client ID: SOUTHERN GAS TANK SOLIDS
Sample Location: SOMERVILLE, MA

Date Collected: 06/12/09 13:35
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Volatile Organics by 8260B/5035 - Westborough Lab					
Isopropyl Ether	ND		ug/kg	270	1
Ethyl-Tert-Butyl-Ether	ND		ug/kg	270	1
Tertiary-Amyl Methyl Ether	ND		ug/kg	270	1
1,4-Dioxane	ND		ug/kg	34000	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	90		70-130
Toluene-d8	113		70-130
4-Bromofluorobenzene	106		70-130
Dibromofluoromethane	78		70-130

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Analytical Method: 60,8260B
Analytical Date: 06/18/09 09:12
Analyst: BN

Parameter	Result	Qualifier	Units	RDL
MCP Volatile Organics by 8260B/5035 - Westborough Lab for sample(s): 01-02 Batch: WG367369-3				
Methylene chloride	ND		ug/kg	500
1,1-Dichloroethane	ND		ug/kg	75
Chloroform	ND		ug/kg	75
Carbon tetrachloride	ND		ug/kg	50
1,2-Dichloropropane	ND		ug/kg	180
Dibromochloromethane	ND		ug/kg	50
1,1,2-Trichloroethane	ND		ug/kg	75
Tetrachloroethene	ND		ug/kg	50
Chlorobenzene	ND		ug/kg	50
Trichlorofluoromethane	ND		ug/kg	250
1,2-Dichloroethane	ND		ug/kg	50
1,1,1-Trichloroethane	ND		ug/kg	50
Bromodichloromethane	ND		ug/kg	50
trans-1,3-Dichloropropene	ND		ug/kg	50
cis-1,3-Dichloropropene	ND		ug/kg	50
1,1-Dichloropropene	ND		ug/kg	250
Bromoform	ND		ug/kg	200
1,1,2,2-Tetrachloroethane	ND		ug/kg	50
Benzene	ND		ug/kg	50
Toluene	ND		ug/kg	75
Ethylbenzene	ND		ug/kg	50
Chloromethane	ND		ug/kg	250
Bromomethane	ND		ug/kg	100
Vinyl chloride	ND		ug/kg	100
Chloroethane	ND		ug/kg	100
1,1-Dichloroethene	ND		ug/kg	50
trans-1,2-Dichloroethene	ND		ug/kg	75
Trichloroethene	ND		ug/kg	50
1,2-Dichlorobenzene	ND		ug/kg	250
1,3-Dichlorobenzene	ND		ug/kg	250
1,4-Dichlorobenzene	ND		ug/kg	250

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Analytical Method: 60,8260B
Analytical Date: 06/18/09 09:12
Analyst: BN

Parameter	Result	Qualifier	Units	RDL
MCP Volatile Organics by 8260B/5035 - Westborough Lab for sample(s): 01-02 Batch: WG367369-3				
Methyl tert butyl ether	ND		ug/kg	100
p/m-Xylene	ND		ug/kg	100
o-Xylene	ND		ug/kg	100
cis-1,2-Dichloroethene	ND		ug/kg	50
Dibromomethane	ND		ug/kg	500
1,2,3-Trichloropropane	ND		ug/kg	500
Styrene	ND		ug/kg	100
Dichlorodifluoromethane	ND		ug/kg	500
Acetone	ND		ug/kg	500
Carbon disulfide	ND		ug/kg	2500
2-Butanone	ND		ug/kg	500
4-Methyl-2-pentanone	ND		ug/kg	500
2-Hexanone	ND		ug/kg	500
Bromochloromethane	ND		ug/kg	250
Tetrahydrofuran	ND		ug/kg	1000
2,2-Dichloropropane	ND		ug/kg	250
1,2-Dibromoethane	ND		ug/kg	200
1,3-Dichloropropane	ND		ug/kg	250
1,1,1,2-Tetrachloroethane	ND		ug/kg	50
Bromobenzene	ND		ug/kg	250
n-Butylbenzene	ND		ug/kg	50
sec-Butylbenzene	ND		ug/kg	50
tert-Butylbenzene	ND		ug/kg	250
o-Chlorotoluene	ND		ug/kg	250
p-Chlorotoluene	ND		ug/kg	250
1,2-Dibromo-3-chloropropane	ND		ug/kg	250
Hexachlorobutadiene	ND		ug/kg	250
Isopropylbenzene	ND		ug/kg	50
p-Isopropyltoluene	ND		ug/kg	50
Naphthalene	ND		ug/kg	250
n-Propylbenzene	ND		ug/kg	50

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Analytical Method: 60,8260B
Analytical Date: 06/18/09 09:12
Analyst: BN

Parameter	Result	Qualifier	Units	RDL
MCP Volatile Organics by 8260B/5035 - Westborough Lab for sample(s): 01-02 Batch: WG367369-3				
1,2,3-Trichlorobenzene	ND		ug/kg	250
1,2,4-Trichlorobenzene	ND		ug/kg	250
1,3,5-Trimethylbenzene	ND		ug/kg	250
1,2,4-Trimethylbenzene	ND		ug/kg	250
Ethyl ether	ND		ug/kg	250
Isopropyl Ether	ND		ug/kg	200
Ethyl-Tert-Butyl-Ether	ND		ug/kg	200
Tertiary-Amyl Methyl Ether	ND		ug/kg	200
1,4-Dioxane	ND		ug/kg	25000

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	93		70-130
Toluene-d8	115		70-130
4-Bromofluorobenzene	110		70-130
Dibromofluoromethane	89		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
MCP Volatile Organics by 8260B/5035 - Westborough Lab Associated sample(s): 01-02 Batch: WG367369-1 WG367369-2					
Methylene chloride	76	75	70-130	1	25
1,1-Dichloroethane	87	88	70-130	1	25
Chloroform	85	82	70-130	4	25
Carbon tetrachloride	86	83	70-130	4	25
1,2-Dichloropropane	86	85	70-130	1	25
Dibromochloromethane	99	102	70-130	3	25
1,1,2-Trichloroethane	97	99	70-130	2	25
Tetrachloroethene	110	112	70-130	2	25
Chlorobenzene	104	104	70-130	0	25
Trichlorofluoromethane	88	84	70-130	5	25
1,2-Dichloroethane	90	87	70-130	3	25
1,1,1-Trichloroethane	85	85	70-130	0	25
Bromodichloromethane	87	88	70-130	1	25
trans-1,3-Dichloropropene	98	100	70-130	2	25
cis-1,3-Dichloropropene	75	75	70-130	0	25
1,1-Dichloropropene	85	85	70-130	0	25
Bromoform	116	108	70-130	7	50
1,1,2,2-Tetrachloroethane	112	105	70-130	6	25
Benzene	82	83	70-130	1	25
Toluene	102	102	70-130	0	25
Ethylbenzene	106	107	70-130	1	25

Lab Control Sample Analysis

Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
MCP Volatile Organics by 8260B/5035 - Westborough Lab Associated sample(s): 01-02 Batch: WG367369-1 WG367369-2					
Chloromethane	72	72	70-130	0	50
Bromomethane	**134**	125	70-130	7	50
Vinyl chloride	83	80	70-130	4	25
Chloroethane	91	88	70-130	3	25
1,1-Dichloroethene	80	74	70-130	8	25
trans-1,2-Dichloroethene	83	83	70-130	0	25
Trichloroethene	73	72	70-130	1	25
1,2-Dichlorobenzene	117	113	70-130	3	25
1,3-Dichlorobenzene	118	116	70-130	2	25
1,4-Dichlorobenzene	119	116	70-130	3	25
Methyl tert butyl ether	95	93	70-130	2	25
p/m-Xylene	110	112	70-130	2	25
o-Xylene	116	118	70-130	2	25
cis-1,2-Dichloroethene	87	86	70-130	1	25
Dibromomethane	86	82	70-130	5	25
1,2,3-Trichloropropane	126	116	70-130	8	25
Styrene	116	117	70-130	1	25
Dichlorodifluoromethane	**66**	**64**	70-130	3	50
Acetone	74	79	70-130	7	50
Carbon disulfide	75	73	70-130	3	50
2-Butanone	126	118	70-130	7	50

Lab Control Sample Analysis

Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
MCP Volatile Organics by 8260B/5035 - Westborough Lab Associated sample(s): 01-02 Batch: WG367369-1 WG367369-2					
4-Methyl-2-pentanone	95	91	70-130	4	50
2-Hexanone	108	102	70-130	6	50
Bromochloromethane	85	85	70-130	0	25
Tetrahydrofuran	92	91	70-130	1	25
2,2-Dichloropropane	91	91	70-130	0	50
1,2-Dibromoethane	106	103	70-130	3	25
1,3-Dichloropropane	101	101	70-130	0	25
1,1,1,2-Tetrachloroethane	105	108	70-130	3	25
Bromobenzene	117	114	70-130	3	25
n-Butylbenzene	115	112	70-130	3	25
sec-Butylbenzene	112	112	70-130	0	25
tert-Butylbenzene	114	114	70-130	0	25
o-Chlorotoluene	110	107	70-130	3	25
p-Chlorotoluene	112	108	70-130	4	25
1,2-Dibromo-3-chloropropane	107	102	70-130	5	50
Hexachlorobutadiene	121	117	70-130	3	25
Isopropylbenzene	113	110	70-130	3	25
p-Isopropyltoluene	119	118	70-130	1	25
Naphthalene	96	93	70-130	3	25
n-Propylbenzene	111	107	70-130	4	25
1,2,3-Trichlorobenzene	115	113	70-130	2	25

Lab Control Sample Analysis

Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
MCP Volatile Organics by 8260B/5035 - Westborough Lab Associated sample(s): 01-02 Batch: WG367369-1 WG367369-2					
1,2,4-Trichlorobenzene	115	115	70-130	0	25
1,3,5-Trimethylbenzene	113	114	70-130	1	25
1,2,4-Trimethylbenzene	116	112	70-130	4	25
Ethyl ether	92	89	70-130	3	25
Isopropyl Ether	91	91	70-130	0	25
Ethyl-Tert-Butyl-Ether	92	93	70-130	1	25
Tertiary-Amyl Methyl Ether	88	87	70-130	1	25
1,4-Dioxane	92	90	70-130	2	50

Surrogate	LCS %Recovery	Qualifier	LCSD %Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	92		91		70-130
Toluene-d8	110		112		70-130
4-Bromofluorobenzene	102		100		70-130
Dibromofluoromethane	86		83		70-130

PETROLEUM HYDROCARBONS

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID:	L0907777-01	Date Collected:	06/12/09 13:55
Client ID:	NORTH TANK SOLIDS	Date Received:	06/12/09
Sample Location:	SOMERVILLE, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8015B(M)	Extraction Date:	06/15/09 12:00
Analytical Date:	06/17/09 15:02		
Analyst:	RT		
Percent Solids:	63%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
Petroleum Hydrocarbon Quantitation - Westborough Lab					
TPH	39400000		ug/kg	5290000	100

Surrogate	% Recovery	Qualifier	Acceptance Criteria
o-Terphenyl	0		40-140

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID:	L0907777-02	Date Collected:	06/12/09 13:35
Client ID:	SOUTHERN GAS TANK SOLIDS	Date Received:	06/12/09
Sample Location:	SOMERVILLE, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8015B(M)	Extraction Date:	06/15/09 12:00
Analytical Date:	06/17/09 10:29		
Analyst:	RT		
Percent Solids:	92%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
Petroleum Hydrocarbon Quantitation - Westborough Lab					
TPH	361000		ug/kg	36200	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
o-Terphenyl	91		40-140

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8015B(M)
Analytical Date: 06/15/09 14:50
Analyst: RT

Extraction Method: EPA 3546
Extraction Date: 06/15/09 12:00

Parameter	Result	Qualifier	Units	RDL
Petroleum Hydrocarbon Quantitation - Westborough Lab for sample(s): 01-02 Batch: WG366830-1				
TPH	ND		ug/kg	33300

Surrogate	%Recovery	Qualifier	Acceptance Criteria
o-Terphenyl	89		40-140

Lab Control Sample Analysis

Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
Petroleum Hydrocarbon Quantitation - Westborough Lab Associated sample(s): 01-02 Batch: WG366830-2					
TPH	64	-	40-140	-	

Surrogate	LCS %Recovery	Qualifier	LCSD %Recovery	Qualifier	Acceptance Criteria
o-Terphenyl	95				40-140

Lab Duplicate Analysis
Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	Native Sample	Duplicate Sample	Units	RPD	RPD Limits
Petroleum Hydrocarbon Quantitation - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG366830-4 QC Sample: L0907741-01 Client ID: DUP Sample					
TPH	ND	77800	ug/kg	NC	40

Surrogate	%Recovery	Qualifier	%Recovery	Qualifier	Acceptance Criteria
o-Terphenyl	63		67		40-140

PCBS

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID:	L0907777-01	Date Collected:	06/12/09 13:55
Client ID:	NORTH TANK SOLIDS	Date Received:	06/12/09
Sample Location:	SOMERVILLE, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	64,8082	Extraction Date:	06/19/09 22:00
Analytical Date:	06/22/09 08:57	Cleanup Method1:	EPA 3665A
Analyst:	SH	Cleanup Date1:	06/20/09
Percent Solids:	63%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Polychlorinated Biphenyls - Westborough Lab					
Aroclor 1242	450		ug/kg	52.9	1
Aroclor 1254	525		ug/kg	52.9	1
Aroclor 1260	231		ug/kg	52.9	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	44		30-150	A
Decachlorobiphenyl	49		30-150	A
2,4,5,6-Tetrachloro-m-xylene	55		30-150	B
Decachlorobiphenyl	76		30-150	B

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID:	L0907777-01	Date Collected:	06/12/09 13:55
Client ID:	NORTH TANK SOLIDS	Date Received:	06/12/09
Sample Location:	SOMERVILLE, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	64,8082	Extraction Date:	06/19/09 22:00
Analytical Date:	06/22/09 08:57	Cleanup Method1:	EPA 3665A
Analyst:	SH	Cleanup Date1:	06/20/09
Percent Solids:	63%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Polychlorinated Biphenyls - Westborough Lab					
Aroclor 1016	ND		ug/kg	52.9	1
Aroclor 1221	ND		ug/kg	52.9	1
Aroclor 1232	ND		ug/kg	52.9	1
Aroclor 1248	ND		ug/kg	52.9	1
Aroclor 1262	ND		ug/kg	52.9	1
Aroclor 1268	ND		ug/kg	52.9	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	44		30-150	A
Decachlorobiphenyl	49		30-150	A
2,4,5,6-Tetrachloro-m-xylene	55		30-150	B
Decachlorobiphenyl	76		30-150	B

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID:	L0907777-02	Date Collected:	06/12/09 13:35
Client ID:	SOUTHERN GAS TANK SOLIDS	Date Received:	06/12/09
Sample Location:	SOMERVILLE, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	64,8082	Extraction Date:	06/15/09 15:33
Analytical Date:	06/16/09 20:46	Cleanup Method1:	EPA 3665A
Analyst:	SH	Cleanup Date1:	06/15/09
Percent Solids:	92%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
MCP Polychlorinated Biphenyls - Westborough Lab					
Aroclor 1016	ND		ug/kg	36.2	1
Aroclor 1221	ND		ug/kg	36.2	1
Aroclor 1232	ND		ug/kg	36.2	1
Aroclor 1242	ND		ug/kg	36.2	1
Aroclor 1248	ND		ug/kg	36.2	1
Aroclor 1254	ND		ug/kg	36.2	1
Aroclor 1260	ND		ug/kg	36.2	1
Aroclor 1262	ND		ug/kg	36.2	1
Aroclor 1268	ND		ug/kg	36.2	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	64		30-150	A
Decachlorobiphenyl	76		30-150	A
2,4,5,6-Tetrachloro-m-xylene	56		30-150	B
Decachlorobiphenyl	74		30-150	B

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Analytical Method: 64,8082
Analytical Date: 06/16/09 19:57
Analyst: SH

Extraction Method: EPA 3546
Extraction Date: 06/15/09 15:33
Cleanup Method1: EPA 3665A
Cleanup Date1: 06/15/09

Parameter	Result	Qualifier	Units	RDL
MCP Polychlorinated Biphenyls - Westborough Lab for sample(s): 02 Batch: WG366888-1				
Aroclor 1016	ND		ug/kg	33.3
Aroclor 1221	ND		ug/kg	33.3
Aroclor 1232	ND		ug/kg	33.3
Aroclor 1242	ND		ug/kg	33.3
Aroclor 1248	ND		ug/kg	33.3
Aroclor 1254	ND		ug/kg	33.3
Aroclor 1260	ND		ug/kg	33.3
Aroclor 1262	ND		ug/kg	33.3
Aroclor 1268	ND		ug/kg	33.3

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	73		30-150	A
Decachlorobiphenyl	75		30-150	A
2,4,5,6-Tetrachloro-m-xylene	74		30-150	B
Decachlorobiphenyl	83		30-150	B

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Analytical Method: 64,8082
Analytical Date: 06/22/09 09:09
Analyst: SH

Extraction Method: EPA 3546
Extraction Date: 06/19/09 22:00
Cleanup Method1: EPA 3665A
Cleanup Date1: 06/20/09

Parameter	Result	Qualifier	Units	RDL
MCP Polychlorinated Biphenyls - Westborough Lab for sample(s): 01 Batch: WG367683-1				
Aroclor 1016	ND		ug/kg	33.3
Aroclor 1221	ND		ug/kg	33.3
Aroclor 1232	ND		ug/kg	33.3
Aroclor 1242	ND		ug/kg	33.3
Aroclor 1248	ND		ug/kg	33.3
Aroclor 1254	ND		ug/kg	33.3
Aroclor 1260	ND		ug/kg	33.3
Aroclor 1262	ND		ug/kg	33.3
Aroclor 1268	ND		ug/kg	33.3

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	68		30-150	A
Decachlorobiphenyl	69		30-150	A
2,4,5,6-Tetrachloro-m-xylene	74		30-150	B
Decachlorobiphenyl	105		30-150	B

Lab Control Sample Analysis

Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
MCP Polychlorinated Biphenyls - Westborough Lab Associated sample(s): 02 Batch: WG366888-2 WG366888-3					
Aroclor 1016	85	83	40-140	2	30
Aroclor 1260	83	78	40-140	6	30

Surrogate	LCS %Recovery	Qualifier	LCSD %Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	80		72		30-150	A
Decachlorobiphenyl	93		81		30-150	A
2,4,5,6-Tetrachloro-m-xylene	76		72		30-150	B
Decachlorobiphenyl	96		84		30-150	B

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
MCP Polychlorinated Biphenyls - Westborough Lab Associated sample(s): 01 Batch: WG367683-2 WG367683-3					
Aroclor 1016	69	83	40-140	18	30
Aroclor 1260	64	75	40-140	16	30

Surrogate	LCS %Recovery	Qualifier	LCSD %Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	67		76		30-150	A
Decachlorobiphenyl	78		80		30-150	A
2,4,5,6-Tetrachloro-m-xylene	71		80		30-150	B
Decachlorobiphenyl	95		106		30-150	B

METALS

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-01
Client ID: NORTH TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil
Percent Solids: 63%

Date Collected: 06/12/09 13:55
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
MCP Total Metals - Westborough Lab										
Arsenic, Total	32		mg/kg	0.63	1	06/15/09 16:15	06/17/09 16:00	EPA 3050B	60,6010B	MG
Cadmium, Total	68		mg/kg	0.63	1	06/15/09 16:15	06/17/09 16:00	EPA 3050B	60,6010B	MG
Chromium, Total	330		mg/kg	0.63	1	06/15/09 16:15	06/17/09 16:00	EPA 3050B	60,6010B	MG
Lead, Total	2200		mg/kg	3.2	1	06/15/09 16:15	06/17/09 16:00	EPA 3050B	60,6010B	MG
Mercury, Total	5.1	E	mg/kg	0.12	1	06/15/09 22:10	06/16/09 13:15	EPA 7471A	64,7471A	EZ
Mercury, Total	5.6		mg/kg	0.61	5	06/15/09 22:10	06/16/09 13:52	EPA 7471A	64,7471A	EZ

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-02
Client ID: SOUTHERN GAS TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil
Percent Solids: 92%
Date Collected: 06/12/09 13:35
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
MCP Total Metals - Westborough Lab										
Arsenic, Total	5.4		mg/kg	0.43	1	06/15/09 16:15	06/17/09 16:25	EPA 3050B	60,6010B	MG
Cadmium, Total	ND		mg/kg	0.43	1	06/15/09 16:15	06/17/09 16:25	EPA 3050B	60,6010B	MG
Chromium, Total	13		mg/kg	0.43	1	06/15/09 16:15	06/17/09 16:25	EPA 3050B	60,6010B	MG
Lead, Total	120		mg/kg	2.1	1	06/15/09 16:15	06/17/09 16:25	EPA 3050B	60,6010B	MG
Mercury, Total	ND		mg/kg	0.09	1	06/15/09 22:10	06/16/09 13:18	EPA 7471A	64,7471A	EZ

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
MCP Total Metals - Westborough Lab for sample(s): 01-02 Batch: WG366911-1									
Arsenic, Total	ND		mg/kg	0.40	1	06/15/09 16:15	06/17/09 15:32	60,6010B	MG
Cadmium, Total	ND		mg/kg	0.40	1	06/15/09 16:15	06/17/09 15:32	60,6010B	MG
Chromium, Total	ND		mg/kg	0.40	1	06/15/09 16:15	06/17/09 15:32	60,6010B	MG
Lead, Total	ND		mg/kg	2.0	1	06/15/09 16:15	06/17/09 15:32	60,6010B	MG

Prep Information

Digestion Method: EPA 3050B

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
MCP Total Metals - Westborough Lab for sample(s): 01-02 Batch: WG366946-1									
Mercury, Total	ND		mg/kg	0.08	1	06/15/09 22:10	06/16/09 12:51	64,7471A	EZ

Prep Information

Digestion Method: EPA 7471A

Lab Control Sample Analysis

Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
MCP Total Metals - Westborough Lab Associated sample(s): 01-02 Batch: WG366911-2 WG366911-3					
Arsenic, Total	101	101	75-125	0	30
Cadmium, Total	102	104	75-125	2	30
Chromium, Total	102	101	75-125	1	30
Lead, Total	102	104	75-125	2	30
MCP Total Metals - Westborough Lab Associated sample(s): 01-02 Batch: WG366946-2 WG366946-3					
Mercury, Total	106	111	75-125	5	30

INORGANICS
&
MISCELLANEOUS

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-01
Client ID: NORTH TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil

Date Collected: 06/12/09 13:55
Date Received: 06/12/09
Field Prep: Not Specified

Test Material Information

Source of Material:	Unknown
Description of Material:	Non-Metallic - Damp Paste
Particle Size:	Medium
Preliminary Burning Time (sec):	120

Parameter	Result	Date Analyzed	Analytical Method	Analyst
Ignitability of Solids - Westborough Lab				
Ignitability	NI	06/12/09 17:25	1,1030	TH

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-02
Client ID: SOUTHERN GAS TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil

Date Collected: 06/12/09 13:35
Date Received: 06/12/09
Field Prep: Not Specified

Test Material Information

Source of Material: Unknown
Description of Material: Non-Metallic - Dry Sand
Particle Size: Medium
Preliminary Burning Time (sec): 120

Parameter	Result	Date Analyzed	Analytical Method	Analyst
Ignitability of Solids - Westborough Lab				
Ignitability	NI	06/12/09 17:25	1,1030	TH

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-01
Client ID: NORTH TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil

Date Collected: 06/12/09 13:55
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab									
Solids, Total	63		%	0.10	1	-	06/16/09 10:09	30,2540G	MC
pH	9.2		SU	-	1	-	06/15/09 20:50	1,9045C	BH
Cyanide, Reactive	ND		mg/kg	10	1	-	06/17/09 15:00	1,7.3	TH
Sulfide, Reactive	ND		mg/kg	10	1	-	06/17/09 15:00	1,7.3	TH

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

SAMPLE RESULTS

Lab ID: L0907777-02
Client ID: SOUTHERN GAS TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil

Date Collected: 06/12/09 13:35
Date Received: 06/12/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab									
Solids, Total	92		%	0.10	1	-	06/16/09 10:09	30,2540G	MC
pH	11.6		SU	-	1	-	06/15/09 20:50	1,9045C	BH
Cyanide, Reactive	ND		mg/kg	10	1	-	06/17/09 15:00	1,7.3	TH
Sulfide, Reactive	ND		mg/kg	10	1	-	06/17/09 15:00	1,7.3	TH

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-02 Batch: WG367281-1									
Sulfide, Reactive	ND		mg/kg	10	1	-	06/17/09 15:00	1,7.3	TH
General Chemistry - Westborough Lab for sample(s): 01-02 Batch: WG367282-1									
Cyanide, Reactive	ND		mg/kg	10	1	-	06/17/09 15:00	1,7.3	TH

Lab Control Sample Analysis
Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 Batch: WG366945-1					
pH	101	-		-	
General Chemistry - Westborough Lab Associated sample(s): 01-02 Batch: WG367281-2					
Sulfide, Reactive	80	-	60-125	-	40
General Chemistry - Westborough Lab Associated sample(s): 01-02 Batch: WG367282-2					
Cyanide, Reactive	67	-	30-125	-	40

Lab Duplicate Analysis
Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Parameter	Native Sample	Duplicate Sample	Units	RPD	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG366945-2 QC Sample: L0907741-06 Client ID: DUP Sample					
pH	8.0	8.0	SU	0	
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG366988-1 QC Sample: L0907757-01 Client ID: DUP Sample					
Solids, Total	35	37	%	6	20
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG367281-3 QC Sample: L0907961-01 Client ID: DUP Sample					
Sulfide, Reactive	ND	ND	mg/kg	NC	40
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG367282-3 QC Sample: L0907961-01 Client ID: DUP Sample					
Cyanide, Reactive	ND	ND	mg/kg	NC	40

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp	Pres	Seal	Analysis
L0907777-01A	Vial MeOH preserved	A	N/A	4.5	Y	Absent	MCP-8260HLW(14)
L0907777-01B	Vial water preserved	A	N/A	4.5	Y	Absent	MCP-8260HLW(14)
L0907777-01C	Vial water preserved	A	N/A	4.5	Y	Absent	MCP-8260HLW(14)
L0907777-01D	Amber 250ml unpreserved	A	N/A	4.5	Y	Absent	IGNIT-1030(14),REACTS(14),MCP-AS-6010T(180),TS(7),MCP-PB-6010T(180),PH-9045(1),MCP-7471T(28),MCP-CD-6010T(180),MCP-CR-6010T(180),REACTCN(14)
L0907777-01E	Amber 250ml unpreserved	A	N/A	4.5	Y	Absent	MCP-8082-04(14),TPH-DRO-D(14)
L0907777-02A	Vial MeOH preserved	A	N/A	4.5	Y	Absent	MCP-8260HLW(14)
L0907777-02B	Vial water preserved	A	N/A	4.5	Y	Absent	MCP-8260HLW(14)
L0907777-02C	Vial water preserved	A	N/A	4.5	Y	Absent	MCP-8260HLW(14)
L0907777-02D	Amber 250ml unpreserved	A	N/A	4.5	Y	Absent	IGNIT-1030(14),REACTS(14),MCP-AS-6010T(180),TS(7),MCP-PB-6010T(180),PH-9045(1),MCP-7471T(28),MCP-CD-6010T(180),MCP-CR-6010T(180),REACTCN(14)
L0907777-02E	Amber 250ml unpreserved	A	N/A	4.5	Y	Absent	MCP-8082-04(14),TPH-DRO-D(14)

*Hold days indicated by values in parentheses

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0907777
Report Date: 06/22/09

GLOSSARY

Acronyms

EPA · Environmental Protection Agency.

LCS · Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD · Laboratory Control Sample Duplicate: Refer to LCS.

MS · Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD · Matrix Spike Sample Duplicate: Refer to MS.

NA · Not Applicable.

NC · Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

ND · Not detected at the reported detection limit for the sample.

NI · Not Ignitable.

RDL · Reported Detection Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD · Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

* · The batch duplicate RPD exceeds the acceptance criteria. This flag is not applicable when the sample concentrations are less than 5x the RDL. (Metals only.)

A · Spectra identified as "Aldol Condensation Product".

B · The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte.

D · Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E · Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

H · The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

N · The matrix spike recovery exceeds the acceptance criteria. This flag is not applicable when the sample concentration is greater than 4x the spike added. (Metals only.)

P · The RPD between the results for the two columns exceeds the method-specified criteria.

R · Analytical results are from sample re-analysis.

RE · Analytical results are from sample re-extraction.

J · Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

Report Format: Data Usability Report

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0907777
Report Date: 06/22/09

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IIIA, 1997.

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

60 Quality Assurance and Quality Control Requirements and Performance Standards for SW-846 Methods. MADEP BWSC. WSC-CAM-IIA (Revision 4), WSC-CAM-V C (Revision 2), WSC-CAM-IIIA (Revision 5). May 2004.

64 Quality Assurance and Quality Control Requirements and Performance Standards for SW-846 Methods. MADEP BWSC. WSC-CAM-IIA (Revision 4), WSC-CAM-V C (Revision 2), WSC-CAM-IIIA (Revision 5). August 2004.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Woods Hole Labs shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Woods Hole Labs.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certificate/Approval Program Summary

Last revised June 17, 2009 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Haloacetic Acids, Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP), Ethylene Dibromide (EDB).)
Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Calcium Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics.)
Solid Waste/Soil (Inorganic Parameters: Lead in Paint, pH, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), Reactivity. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Extractable Petroleum Hydrocarbons (ETPH), Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Volatile Organics, Acid Extractables (Phenols), 3.3'-Dichlorobenzidine, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9221E, 9222B, 9222D, 9223B, EPA 150.1, 180.1, 300.0, 353.2, SM2130B, 2320B, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B,4500NO3-F, EPA 200.7, EPA 200.8, 245.1. Organic Parameters: 504.1, 524.2, SM 6251B.)
Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 350.1, 351.1, 353.2, 410.4, 420.1, Lachat 10-107-06-1-B, SM2320B, 2340B, 2510B, 2540C, 2540D, 426C, 4500Cl-D, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-B, 4500Norg-C, 4500NH3-B, 4500NH3-G, 4500NH3-H, 4500NO3-F, 4500P-B.5, 4500P-E, 5210B, 5220D, 5310C, EPA 200.7, 200.8, 245.1. Organic Parameters: 608, 624.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water
Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl)
(EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Nitrite-N, Fluoride, Sulfate)
353.2 for: Nitrate-N, Nitrite-N; SM4500NO3-F, 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, EPA 150.1, SM4500H-B.
Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics)
(504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), SM6251B, 314.0.

Non-Potable Water
Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn)
(EPA 200.7 for: Al,Sb,As,Be,Cd,Cr,Co,Cu,Fe,Pb,Mn,Mo,Ni,Se,Ag,Sr,Tl,Ti,V,Zn,Ca,Mg,Na,K)
245.1, SM4500H,B, EPA 120.1, SM2510B, 2540C, 2540B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Nitrate-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-B,C-Titr, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CN-CE, 2540D, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics)
(608 for: Chlordane, Aldrin, Dieldrin, DDD, DDE, DDT, Heptachlor, Heptachlor Epoxide, PCB-Water)
600/4-81-045-PCB-Oil

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water
Microbiology Parameters: SM9215B; MF-SM9222B; ENZ. SUB. SM9223; EC-SM9221E; MF-SM9222D; ENZ. SUB. SM9223;

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM6215B, 9222B, 9223B Colilert, EPA 200.7, 200.8, 245.2, 110.2, 120.1, 150.1, 300.0, 325.2, 314.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 331.0. Organic Parameters: 504.1, 524.2, SM6251B.)
Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 200.7, 200.8, 245.1, 245.2, SW-846 6010B, 6020, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 150.1, 300.0, 305.1, 310.1, 325.2, 340.2, 350.1, 350.2, 351.1, 353.2, 354.1, 365.2, 375.4, 376.2, 405.1, 415.1, 420.1, 425.1, 1664A, SW-846 9010, 9030, 9040B, EPA 160.1, 160.2, 160.3, SM426C, SM2310B, 2540B, 2540D, 4500H+B, 4500NH3-H, 4500NH3-E, 4500NO2-B, 4500P-E, 4500-S2-D, 5210B, 2320B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-117-07-1-B, LACHAT 10-107-06-1-B, LACHAT 10-107-04-1-C, LACHAT 10-107-04-1-J, LACHAT 10-117-07-1-A, SM4500CL-E, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D. Organic Parameters: SW-846 3005A, 3015A, 3510C, 5030B, 8021B, 8260B, 8270C, 8330, EPA 624, 625, 608, SW-846 8082, 8081A.)
Solid & Chemical Materials (Inorganic Parameters: SW-846 6010B, 7196A, 7471A, 7.3.3.2, 7.3.4.2, 1010, 1030, 9010, 9012A, 9014, 9030B, 9040, 9045C, 9050C, 1311, 3005A, 3050B, 3051A. Organic Parameters: SW-846 3540C, 3545, 3580A, 5030B, 5035, 8021B, 8260B, 8270C, 8330, 8151A, 8082, 8081A.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 2540C, 2320B, 314.0, 331.0, 110.2, SM2120B, 2510B, 5310C, EPA 150.1, SM4500H-B, EPA 200.8, 245.2. Organic Parameters: 504.1, SM6251B, 524.2.)
Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.1, SM5220D, 4500Cl-D, EPA 300.0, SM2120B, SM4500F-BC, EPA 200.7, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310B, C or D, 4500-PE, EPA 420.1, SM4500P-B5+E, 2540B, 2540C, 2540D, EPA 120.1, SM2510B, SM15 426C, SM9221CE, 9222D, 9221B, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, EPA 350.2/.1, SM5210B, SW-846 3015, 6020, 7470A, 5540C, 4500H-B, EPA 200.8, SM3500Cr-D, EPA 245.1, 245.2, SW-846 9040B, 3005A, EPA 6010B, 7196A, SW-846 9010B, 9030B. Organic Parameters: SW-846 8260B, 8270C, 3510C, EPA 608, 624, 625, SW-846 5030B, 8021B, 8081A, 8082, 8151A, 8330, NJ OQA-QAM-025 Rev.7.)
Solid & Chemical Materials (Inorganic Parameters: SW-846 9040B, 3005A, 6010B, 7196A, 5030B, 9010B, 9030B, 1030, 1311, 3050B, 3051, 7471A, 9014, 9012A, 9045C, 9050A, 9065. Organic Parameters: SW-846 8021B, 8081A, 8082, 8151A, 8330, 8260B, 8270C, 1311, 1312, 3540C, 3545, 3550B, 3580A, 5035L, 5035H, NJ OQA-QAM-025 Rev.7.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 8215B, EPA 200.8, 200.7, 245.2, SM5310C, EPA 314.0, 331.0, SM2320B, EPA 300.0, 325.2, 110.2, SM2120B, 4500CN-E, 4500F-C, EPA 150.1, SM4500H-B, 4500NO3-F, 2540C, EPA 120.1, SM 2510B. Organic Parameters: EPA 524.2, 504.1, SM6251B.)
Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, EPA 405.1, SM5210B, EPA 410.4, SM5220D, EPA 305.1, SM2310B-4a, EPA 310.1, SM2320B, EPA 200.7, 300.0, 325.2, LACHAT 10-117-07-1A or B, SM4500Cl-E, EPA 340.2, SM4500F-C, EPA 375.4, SM15 426C, EPA 350.1, 350.2, LACHAT 10-107-06-1-B, SM4500NH3-H, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, LACHAT 10-107-041-C, SM4500-NO30F, EPA 354.1, SM4500-NO2-B, EPA 365.2, SM4500P-E, EPA 160.3, EPA 160.1, SM2540C, EPA 160.2, SM2540D, EPA 200.8, EPA 6010B, 6020, EPA 7196A, S\M3500Cr-D, EPA 245.1, 245.2, 7470A, 110.2, SM2120B, 335.2, LACHAT 10-204-00-1-A, EPA 150.1, 9040B, SM4500-HB, EPA 1664A, EPA 415.1, SM5310C, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, EPA 376.2, SM4500S-D, EPA 425.1, SM5540C, EPA 3005A, 3015. Organic Parameters: EPA 624, 8260B, 8270C, 625, 608, 8081A, 8151A, 8330, 8082, 8021B, EPA 3510C, 5030B, 9010B, 9030B.)
Solid & Hazardous Waste (Inorganic Parameters: EPA 9040B, 9045C, 1010, 1030, SW-846 Ch 7 Sec 7.3, EPA 6010B, 7196A, 7471A, 9012A, 9014, 9040B, 9045C, 9065, 9050, EPA 1311, 3005A, 3050B, 3051, 9010B, 9030B. Organic Parameters: EPA 8260B, 8270C, 8081A, 8151A, 8330, 8082, 8021B, 3540C, 3545, 3580, 5030B, 5035.)
Analytical Services Protocol: CLP Volatile Organics, CLP Inorganics, CLP PCB/Pesticides.

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NY-DOH.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NY-DOH Certificate for Potable and Non-Potable Water.

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Non-Potable Water (Organic Parameters: EPA 3510C, 625, 608, 8081A, 8082, 8151A, 8270C, 8330)
Solid & Hazardous Waste (Inorganic Parameters: EPA 1010, 1030, 1311, 3050B, 3051, 6010B, EPA 7.3.3.2, EPA 7.3.4.2, 7196A, 7471A, 9010B, 9012A, 9014, 9040B, 9045C, 9050, 9065. Organic Parameters: 3540C, 3545, 3580A, 5035, 8021B, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

06220915:20

CHAIN OF CUSTODY

PAGE 1 OF 1

ALPHA ANALYTICAL

WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193

MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab: 06/12/09

ALPHA Job #: L0907777

Client Information

Client: Sanborn, Head, + Assoc

Address: 1 Technology Park Dr
Westford MA 01886

Phone: 978-392-0900

Fax: 978-392-0987

Email: dwood@sanbornhead.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: 515 Somerville Ave

Project Location: Somerville, MA

Project #: 2315.03

Project Manager: Duncan Wood

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: 06/19/09 Time:

Report Information - Data Deliverables

☐ FAX ☐ EMAIL

☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program	Criteria
MCP	GW-1

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTO-

☒ Yes ☐ No Are MCP Analytical Methods Required?

☐ Yes ☒ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	8260 (Low)	8260 (High)	TPH-DRO-Diss, PH, Red, Red	TCRA'S	Sample Specific Comments	TOTAL # BOTTLES
7777 1	North Tank Solids	6/12/09	13:55	S	SAW	X	X	X	X		5
2	Southern Gas Tank Solids	6/12/09	13:35	S	SAW	X	X	X	X		5
	Temp Blank										1

SAMPLE HANDLING

Filtration
☐ Done
☒ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

Container Type	AV	AV	A	A
Preservative	O	F	A	A

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
Sarah Whitcomb	6/12/09 16:10	Lori Cunningham	6/12/09 16:10

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)

ALPHA ANALYTICAL

ANALYTICAL REPORT

Lab Number:	L0908376
Client:	Sanborn, Head & Associates, Inc. 1 Technology Park Drive Westford, MA 01886
ATTN:	Duncan Wood
Project Name:	515 SOMERVILLE AVE
Project Number:	2315.03
Report Date:	06/29/09

Certifications & Approvals: MA (M-MA086), NY NELAC (11148), CT (PH-0574), NH (2003), NJ (MA935), RI (LAO00065), ME (MA0086), PA (Registration #68-03671), USDA (Permit #S-72578), US Army Corps of Engineers, Naval FESC.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0908376
Report Date: 06/29/09

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L0908376-01	NORTH TANK SOLIDS	SOMERVILLE, MA	06/12/09 13:55
L0908376-02	SOUTHERN GAS TANK SOLIDS	SOMERVILLE, MA	06/12/09 13:35

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0908376
Report Date: 06/29/09

MADEP MCP Response Action Analytical Report Certification

This form provides certifications for all samples performed by MCP methods. Please refer to the Sample Results and Container Information sections of this report for specification of MCP methods used for each analysis. The following questions pertain only to MCP Analytical Methods.

	An affirmative response to questions A, B, C & D is required for "Presumptive Certainty" status	
A	Were all samples received by the laboratory in a condition consistent with those described on their Chain-of-Custody documentation for the data set?	YES
B	Were all QA/QC procedures required for the specified analytical methods(s) included in this report followed, including the requirement to note and discuss in a narrative QC data that did not meet appropriate performance standards or guidelines?	YES
C	Does the analytical data included in this report meet all the requirements for "Presumptive Certainty", as described in section 2.0 of the MADEP document CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	YES
D	VPH and EPH methods only: Was the VPH or EPH method run without significant modifications, as specified in Section 11.3?	N/A
	A response to questions E and F is required for "Presumptive Certainty" status	
E	Were all QC performance standards and recommendations for the specified method(s) achieved?	YES
F	Were results for all analyte-list compounds/elements for the specified method(s) reported?	YES

For any questions answered "No", please refer to the case narrative section on the following page(s).

Please note that sample matrix information is located in the Sample Results section of this report.

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0908376
Report Date: 06/29/09

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

MCP Related Narratives

Report Submission

All MCP required questions were answered with affirmative responses; therefore, there are no relevant data issues to discuss.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Michelle M. Morris

Title: Technical Director/Representative

Date: 06/29/09

METALS

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0908376
Report Date: 06/29/09

SAMPLE RESULTS

Lab ID: L0908376-01
Client ID: NORTH TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil
Date Collected: 06/12/09 13:55
Date Received: 06/12/09
Field Prep: Not Specified
TCLP/SPLP Ext. Date: 06/24/09 15:15

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
TCLP Metals by EPA 1311 - Westborough Lab										
Cadmium, TCLP	0.35		mg/l	0.10	1	06/26/09 14:00	06/26/09 18:00	EPA 3015	1,6010B	AI
Chromium, TCLP	0.23		mg/l	0.20	1	06/26/09 14:00	06/26/09 18:00	EPA 3015	1,6010B	AI
Lead, TCLP	0.60		mg/l	0.50	1	06/26/09 14:00	06/26/09 18:00	EPA 3015	1,6010B	AI
Mercury, TCLP	ND		mg/l	0.0010	1	06/25/09 19:00	06/26/09 12:57	EPA 7470A	1,7470A	EZ

Project Name: 515 SOMERVILLE AVE
Lab Number: L0908376
Project Number: 2315.03
Report Date: 06/29/09

SAMPLE RESULTS

Lab ID: L0908376-02
Client ID: SOUTHERN GAS TANK SOLIDS
Sample Location: SOMERVILLE, MA
Matrix: Soil

Date Collected: 06/12/09 13:35
Date Received: 06/12/09
Field Prep: Not Specified
TCLP/SPLP Ext. Date: 06/24/09 15:15

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
TCLP Metals by EPA 1311 - Westborough Lab										
Lead, TCLP	ND		mg/l	0.50	1	06/26/09 14:00	06/26/09 18:18	EPA 3015	1,6010B	AI

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0908376
Report Date: 06/29/09

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
TCLP Metals by EPA 1311 - Westborough Lab for sample(s): 01 Batch: WG368472-1									
Mercury, TCLP	ND		mg/l	0.0010	1	06/25/09 19:00	06/26/09 12:43	1,7470A	EZ

Prep Information

Digestion Method: EPA 7470A
TCLP Extraction Date: 06/24/09 15:15

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
TCLP Metals by EPA 1311 - Westborough Lab for sample(s): 01-02 Batch: WG368620-1									
Cadmium, TCLP	ND		mg/l	0.10	1	06/26/09 14:00	06/26/09 17:51	1,6010B	AI
Chromium, TCLP	ND		mg/l	0.20	1	06/26/09 14:00	06/26/09 17:51	1,6010B	AI
Lead, TCLP	ND		mg/l	0.50	1	06/26/09 14:00	06/26/09 17:51	1,6010B	AI

Prep Information

Digestion Method: EPA 3015
TCLP Extraction Date: 06/24/09 15:15

Lab Control Sample Analysis
Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0908376
Report Date: 06/29/09

Parameter	LCS %Recovery	LCSD %Recovery	%Recovery Limits	RPD	RPD Limits
TCLP Metals by EPA 1311 - Westborough Lab Associated sample(s): 01 Batch: WG368472-2					
Mercury, TCLP	110	-	80-120	-	
TCLP Metals by EPA 1311 - Westborough Lab Associated sample(s): 01-02 Batch: WG368620-2					
Cadmium, TCLP	100	-	75-125	-	20
Chromium, TCLP	94	-	75-125	-	20
Lead, TCLP	96	-	75-125	-	20

Matrix Spike Analysis
Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0908376
Report Date: 06/29/09

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	MSD Found	MSD %Recovery	Recovery Limits	RPD	RPD Limits
TCLP Metals by EPA 1311 - Westborough Lab Associated sample(s): 01 QC Batch ID: WG368472-4 QC Sample: L0908376-01 Client ID: NORTH TANK SOLIDS									
Mercury, TCLP	ND	0.005	0.0062	124	-	-	70-130	-	20
TCLP Metals by EPA 1311 - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG368620-4 QC Sample: L0908376-01 Client ID: NORTH TANK SOLIDS									
Cadmium, TCLP	0.35	10	10	96	-	-	75-125	-	20
Chromium, TCLP	0.23	10	9.4	92	-	-	75-125	-	20
Lead, TCLP	0.60	10	10	94	-	-	75-125	-	20

Lab Duplicate Analysis
Batch Quality Control

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0908376
Report Date: 06/29/09

Parameter	Native Sample	Duplicate Sample	Units	RPD	RPD Limits
TCLP Metals by EPA 1311 - Westborough Lab Associated sample(s): 01 QC Batch ID: WG368472-3 QC Sample: L0908376-01 Client ID: NORTH TANK SOLIDS					
Mercury, TCLP	ND	ND	mg/l	NC	20
TCLP Metals by EPA 1311 - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG368620-3 QC Sample: L0908376-01 Client ID: NORTH TANK SOLIDS					
Cadmium, TCLP	0.35	0.34	mg/l	3	20
Chromium, TCLP	0.23	0.22	mg/l	4	20
Lead, TCLP	0.60	0.56	mg/l	7	20

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03

Lab Number: L0908376
Report Date: 06/29/09

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp	Pres	Seal	Analysis
L0908376-01A	Amber 250ml unpreserved	A	N/A	4.5	Y	Absent	-
L0908376-01X	Plastic 250ml HNO3 preserved spl	A	<2	4.5	Y	Absent	CD-CI(180),HG-C(28),PB-CI(180),CR-CI(180)
L0908376-02A	Amber 250ml unpreserved	A	N/A	4.5	Y	Absent	-
L0908376-02X	Plastic 250ml HNO3 preserved spl	A	<2	4.5	Y	Absent	PB-CI(180)

*Hold days indicated by values in parentheses

Project Name:	515 SOMERVILLE AVE	**Lab Number:**	L0908376
Project Number:	2315.03	**Report Date:**	06/29/09

GLOSSARY

Acronyms

EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
ND	- Not detected at the reported detection limit for the sample.
NI	- Not Ignitable.
RDL	- Reported Detection Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

*	- The batch duplicate RPD exceeds the acceptance criteria. This flag is not applicable when the sample concentrations are less than 5x the RDL. (Metals only.)
A	- Spectra identified as "Aldol Condensation Product".
B	- The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte.
D	- Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
E	- Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
H	- The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
N	- The matrix spike recovery exceeds the acceptance criteria. This flag is not applicable when the sample concentration is greater than 4x the spike added. (Metals only.)
P	- The RPD between the results for the two columns exceeds the method-specified criteria.
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
J	- Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

Report Format: Data Usability Report

Project Name: 515 SOMERVILLE AVE
Project Number: 2315.03
Lab Number: L0908376
Report Date: 06/29/09

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IIIA, 1997.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Woods Hole Labs shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Woods Hole Labs.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certificate/Approval Program Summary

Last revised June 24, 2009 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Haloacetic Acids, Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP), Ethylene Dibromide (EDB).)
Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Calcium Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics.)
Solid Waste/Soil (Inorganic Parameters: Lead in Paint, pH, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), Reactivity. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Extractable Petroleum Hydrocarbons (ETPH), Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Volatile Organics, Acid Extractables (Phenols), 3.3'-Dichlorobenzidine, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9221E, 9222B, 9222D, 9223B, EPA 150.1, 180.1, 300.0, 353.2, SM2130B, 2320B, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B,4500NO3-F, EPA 200.7, EPA 200.8, 245.1. Organic Parameters: 504.1, 524.2, SM 6251B.)
Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 350.1, 351.1, 353.2, 410.4, 420.1, Lachat 10-107-06-1-B, SM2320B, 2340B, 2510B, 2540C, 2540D, 426C, 4500Cl-D, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-B, 4500Norg-C, 4500NH3-B, 4500NH3-G, 4500NH3-H, 4500NO3-F, 4500P-B.5, 4500P-E, 5210B, 5220D, 5310C, EPA 200.7, 200.8, 245.1. Organic Parameters: 608, 624.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water
Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl)
(EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Nitrite-N, Fluoride, Sulfate)
353.2 for: Nitrate-N, Nitrite-N; SM4500NO3-F, 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, EPA 150.1, SM4500H-B.
Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics)
(504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), SM6251B, 314.0.

Non-Potable Water
Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn)
(EPA 200.7 for: Al,Sb,As,Be,Cd,Cr,Co,Cu,Fe,Pb,Mn,Mo,Ni,Se,Ag,Sr,Tl,Ti,V,Zn,Ca,Mg,Na,K)
245.1, SM4500H,B, EPA 120.1, SM2510B, 2540C, 2540B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Nitrate-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-B,C-Titr, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CN-CE, 2540D, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics)
(608 for: Chlordane, Aldrin, Dieldrin, DDD, DDE, DDT, Heptachlor, Heptachlor Epoxide, PCB-Water)
600/4-81-045-PCB-Oil

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water
Microbiology Parameters: SM9215B; MF-SM9222B; ENZ. SUB. SM9223; EC-SM9221E; MF-SM9222D; ENZ. SUB. SM9223;

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM6215B, 9222B, 9223B Colilert, EPA 200.7, 200.8, 245.2, 110.2, 120.1, 150.1, 300.0, 325.2, 314.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 331.0. Organic Parameters: 504.1, 524.2, SM6251B.)
Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 200.7, 200.8, 245.1, 245.2, SW-846 6010B, 6020, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 150.1, 300.0, 305.1, 310.1, 325.2, 340.2, 350.1, 350.2, 351.1, 353.2, 354.1, 365.2, 375.4, 376.2, 405.1, 415.1, 420.1, 425.1, 1664A, SW-846 9010, 9030, 9040B, EPA 160.1, 160.2, 160.3, SM426C, SM2310B, 2540B, 2540D, 4500H+B, 4500NH3-H, 4500NH3-E, 4500NO2-B, 4500P-E, 4500-S2-D, 5210B, 2320B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-117-07-1-B, LACHAT 10-107-06-1-B, LACHAT 10-107-04-1-C, LACHAT 10-107-04-1-J, LACHAT 10-117-07-1-A, SM4500CL-E, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D. Organic Parameters: SW-846 3005A, 3015A, 3510C, 5030B, 8021B, 8260B, 8270C, 8330, EPA 624, 625, 608, SW-846 8082, 8081A.)
Solid & Chemical Materials (Inorganic Parameters: SW-846 6010B, 7196A, 7471A, 7.3.3.2, 7.3.4.2, 1010, 1030, 9010, 9012A, 9014, 9030B, 9040, 9045C, 9050C, 1311, 3005A, 3050B, 3051A. Organic Parameters: SW-846 3540C, 3545, 3580A, 5030B, 5035, 8021B, 8260B, 8270C, 8330, 8151A, 8082, 8081A.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 2540C, 2320B, 314.0, 331.0, 110.2, SM2120B, 2510B, 5310C, EPA 150.1, SM4500H-B, EPA 200.8, 245.2. Organic Parameters: 504.1, SM6251B, 524.2.)
Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.1, SM5220D, 4500Cl-D, EPA 300.0, SM2120B, SM4500F-BC, EPA 200.7, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310B, C or D, 4500-PE, EPA 420.1, SM4500P-B5+E, 2540B, 2540C, 2540D, EPA 120.1, SM2510B, SM15 426C, SM9221CE, 9222D, 9221B, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, EPA 350.2/.1, SM5210B, SW-846 3015, 6020, 7470A, 5540C, 4500H-B, EPA 200.8, SM3500Cr-D, EPA 245.1, 245.2, SW-846 9040B, 3005A, EPA 6010B, 7196A, SW-846 9010B, 9030B. Organic Parameters: SW-846 8260B, 8270C, 3510C, EPA 608, 624, 625, SW-846 5030B, 8021B, 8081A, 8082, 8151A, 8330, NJ OQA-QAM-025 Rev.7.)
Solid & Chemical Materials (Inorganic Parameters: SW-846 9040B, 3005A, 6010B, 7196A, 5030B, 9010B, 9030B, 1030, 1311, 3050B, 3051, 7471A, 9014, 9012A, 9045C, 9050A, 9065. Organic Parameters: SW-846 8021B, 8081A, 8082, 8151A, 8330, 8260B, 8270C, 1311, 1312, 3540C, 3545, 3550B, 3580A, 5035L, 5035H, NJ OQA-QAM-025 Rev.7.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 8215B, EPA 200.8, 200.7, 245.2, SM5310C, EPA 314.0, 331.0, SM2320B, EPA 300.0, 325.2, 110.2, SM2120B, 4500CN-E, 4500F-C, EPA 150.1, SM4500H-B, 4500NO3-F, 2540C, EPA 120.1, SM 2510B. Organic Parameters: EPA 524.2, 504.1, SM6251B.)
Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, EPA 405.1, SM5210B, EPA 410.4, SM5220D, EPA 305.1, SM2310B-4a, EPA 310.1, SM2320B, EPA 200.7, 300.0, 325.2, LACHAT 10-117-07-1A or B, SM4500Cl-E, EPA 340.2, SM4500F-C, EPA 375.4, SM15 426C, EPA 350.1, 350.2, LACHAT 10-107-06-1-B, SM4500NH3-H, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, LACHAT 10-107-041-C, SM4500-NO30F, EPA 354.1, SM4500-NO2-B, EPA 365.2, SM4500P-E, EPA 160.3, EPA 160.1, SM2540C, EPA 160.2, SM2540D, EPA 200.8, EPA 6010B, 6020, EPA 7196A, S\M3500Cr-D, EPA 245.1, 245.2, 7470A, 110.2, SM2120B, 335.2, LACHAT 10-204-00-1-A, EPA 150.1, 9040B, SM4500-HB, EPA 1664A, EPA 415.1, SM5310C, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, EPA 376.2, SM4500S-D, EPA 425.1, SM5540C, EPA 3005A, 3015. Organic Parameters: EPA 624, 8260B, 8270C, 625, 608, 8081A, 8151A, 8330, 8082, 8021B, EPA 3510C, 5030B, 9010B, 9030B.)
Solid & Hazardous Waste (Inorganic Parameters: EPA 9040B, 9045C, 1010, 1030, SW-846 Ch 7 Sec 7.3, EPA 6010B, 7196A, 7471A, 9012A, 9014, 9040B, 9045C, 9065, 9050, EPA 1311, 3005A, 3050B, 3051, 9010B, 9030B. Organic Parameters: EPA 8260B, 8270C, 8081A, 8151A, 8330, 8082, 8021B, 3540C, 3545, 3580, 5030B, 5035.)
Analytical Services Protocol: CLP Volatile Organics, CLP Inorganics, CLP PCB/Pesticides.

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Non-Potable Water (Organic Parameters: EPA 3510C, 625, 608, 8081A, 8082, 8151A, 8270C, 8330)
Solid & Hazardous Waste (Inorganic Parameters: EPA 1010, 1030, 1311, 3050B, 3051, 6010B, EPA 7.3.3.2, EPA 7.3.4.2, 7196A, 7471A, 9010B, 9012A, 9014, 9040B, 9045C, 9050, 9065. Organic Parameters: 3540C, 3545, 3580A, 5035, 8021B, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NY-DOH.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NY-DOH Certificate for Potable and Non-Potable Water.

Utah Department of Health Certificate/Lab ID: AAMA. ***NELAP Accredited.***
Non-Potable Water (Inorganic Parameters: Chloride EPA 300.0)

06290914:37

CHAIN OF CUSTODY

PAGE 1 OF 1

ALPHA TECHNICAL

WESTBORO, MA TEL 508-898-9220 FAX 508-898-9193

MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab: 6/12/09

ALPHA Job #: L0908376

Client Information

Client: Sanborn, Head & Assoc

Address:

Phone:

Fax

Email:

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: 515 Somerville Ave

Project Location: Somerville, MA

Project #: 2315.03

Project Manager: Duncan Wood

ALPHA Quote #:

Turn-Around Time

☐ Standard ☒ RUSH (only confirmed if pre-approved!) 4 day

Date Due: 6/29/09 Time:

Report Information - Data Deliverables

☐ FAX ☐ EMAIL

☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program	Criteria
MCP	S-1

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTO-

☒ Yes ☐ No Are MCP Analytical Methods Required?

☐ Yes ☒ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

Relog of L0907777-01

ANALYSIS: TCLP Cd,Cr,Pb,Hg; TCLP Pb

SAMPLE HANDLING

Filtration ☐ Done ☐ Not needed ☐ Lab to do

Preservation ☐ Lab to do (Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	TCLP Cd,Cr,Pb,Hg	TCLP Pb	Sample Specific Comments	TOTAL # BOTTLES
8376-01	North Tank Solids	6/12/09	13:55	S		X			
8376-02	Southern Gas Tank Solids	6/12/09	13:35	S			X		

Container Type

Preservative

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP *or* CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
			6/12/09 1610

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev 14-OCT-07)

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 06/12/09

ALPHA Job #: L0907777

ALPHA ANALYTICAL
WESTBORO, MA TEL 508-898-9220 FAX: 508-898-9193
MANSFIELD MA TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: Sanborn, Head, + Assoc
Address: 1 Technology Park Dr
Westford MA 01886
Phone: 978-392-0900
Fax: 978-392-0987
Email: dwood@sanbornhead.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: 515 Somerville Ave
Project Location: Somerville, MA
Project #: 2315.03
Project Manager: Duncan Wood
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)
Date Due: 06/19/09 Time:

Report Information - Data Deliverables

☐ FAX ☐ EMAIL
☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info FO #:

Regulatory Requirements/Report Limits

State /Fed Program	Criteria
MCP	GW-1

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTO-

☒ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☒ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS: 8260 (Low)	8260 (High)	TPH-DRO-ADS, MA Ref. Fuels	TCLP's	SAMPLE HANDLING	TOTAL # BOTTLES
7777 1	NorthTankSolids	6/12/09	13:55	S	SAW	X	X	X	X		5
2	SouthernGasTankSolids	6/12/09	13:35	S	SAW	X	X	X	X		5
	Temp Blank										1

SAMPLE HANDLING
Filtration
☐ Done
☒ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

Sample Specific Comments

Container Type	AV	AV	A	A
Preservative	O	F	A	A

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	6/12/09 16:20	[signature]	6/12/09 16:10

Please print clearly, legibly and completely. Samples can not be logged and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev 14-OCT-07)

APPENDIX G

DISPOSAL DOCUMENTS RELATIVE TO RTN 3-23606

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012A

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number*: 3 - 23606

A. LOCATION OF SITE OR DISPOSAL SITE WHERE REMEDIATION WASTE WAS GENERATED:

Release Name (optional):
Street: 515 Somerville Avenue Location Aid:
City/Town: Somerville ZIP Code: 02143-0000
Date/Period of Generation: June 11, 2009 to: June 12,2009
Additional Release Tracking Numbers Associated with this Bill of Lading:
*Note: If this Bill of Lading is the result of a Limited Removal Action (LRA) taken prior to Notification, a Release Tracking Number is not needed.

B. PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH BILL OF LADING:

Name of Organization: World 115 Nominee Trust
Name of Contact: Mark Coppola Title: Trustee
Street: 127A Watertown Street
City/Town: Newton State: MA ZIP Code: 02459-0000
Telephone: (617) 969-4154 Ext:

C. RELATIONSHIP TO RELEASE OF PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH BILL OF LADING:

☑ RP or PRP Specify: ☐ Owner ☐ Operator ☐ Generator ☐ Transporter Other RP or PRP: Eligible Person,defined by
☐ Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)
☐ Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 3(j)) M.G.L. Chpy. 21E, s.2
☐ Other Person:

If an owner and/or operator is not conducting the response action associated with the Bill of Lading, provide on an attachment the name, contact person, address and telephone number, including any area code and extension, for each, if known.

D. TRANSPORTER OR COMMON CARRIER INFORMATION:

Transporter/Common Carrier Name: Removal Specialists
Contact Person: Shawn P. Clarke, Sr. Title: President
Street: PO Box 8069
City/Town: Lynn State: MA ZIP Code: 01904
Telephone: (781) 593-8666 Ext:

E. RECEIVING FACILITY/TEMPORARY STORAGE LOCATION:

Operator/Facility Name: Aggregate Recycling Corporation
Contact Person: John Doherty Title: CEO
Street: 434 Dow Highway
City/Town: Eliot State: ME ZIP Code: 03903
Telephone: 781-341-5580 Ext:
Type of Facility: (check one) ☑ Asphalt Batch/Cold Mix ☐ Landfill/Disposal ☐ Incinerator ☐ Temporary Storage
☐ Asphalt Batch/Hot Mix ☐ Landfill/Daily Cover ☐ Other:
☐ Thermal Processing ☐ Landfill/Structural Fill
EPA Identification #:
Division of Hazardous Waste/Class A Permit #: Division of Solid Waste Management Permit #: S021819[illegible]
Actual/Anticipated Period of Temporary Storage (specify dates if applicable): to:
Reason for Temporary Storage:

Revised 10/2004 Page 1 of 3

For ARC Use Only

GENERATOR'S WASTE PROFILE SHEET

AGGREGATE RECYCLING CORPORATION

A. Generator Information

1. GENERATOR NAME: World 115 Nominee Trust
2. SITE STREET ADDRESS: PO Box 95025
3. SITE CITY, STATE: Newton, MA 02495
4. TECHNICAL CONTACT: Duncan Wood 5. PHONE: 603-415-6162

B. Site Description

1. CURRENT SITE USAGE: Construction site, former commercial laundry and fabric cutting shop
2. PROCESS GENERATING WASTE: Removal of abandoned gasoline tanks

C. Material Description

1. CONTAMINANTS:

VIRGIN PRODUCT

xxx GASOLINE	____ # 6 FUEL OIL	____ LUBE / CUTTING OIL
____ KEROSENE	____ MOTOR OIL	____ JP-4 / JET-A / JET FUEL
____ DIESEL	____ HYDRAULIC FLUID	____ OTHER (EXPLAIN):
____ # 2 FUEL OIL	____ MINERAL OIL	____
____ # 4 FUEL OIL	____ TRANSMISSION OIL	____

[ ] WASTE OIL

2. APPROXIMATE THE AMOUNT OF DEBRIS IN THIS MATERIAL: 10 %
ARC RETAINS THE OPTION OF CHARGING FOR DEBRIS IN EXCESS OF 15% UNLESS PREVIOUS ARRANGEMENTS ARE MADE.

3. HAS THIS SITE REMEDIATION BEEN SUPERVISED BY THE STATE OF MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION?

[ ] YES [xxx] NO

IF YES, PLEASE ATTACH SOIL SHIPMENT LETTER

4. CERTIFICATION - Please initial all appropriate sections:

MC I certify that, to the best of my knowledge, the waste material submitted to ARC does not contain regulated quantities of polychlorinated biphenyls, as defined by 40 CFR Part 761.

MC I certify that, based on knowledge of the site, the materials submitted to ARC are generated from remedial activities associated with a Petroleum Underground Storage Tank System regulated under 40 CFR Part 280. As such, this material is delisted from regulation under TCLP for Volatile and Semi-Volatile constituents.

[ ] I certify that, based on knowledge of the site, the materials submitted to ARC are generated from remedial activities involving a Petroleum Storage Tank used for the storage of heating oil for consumptive use on the premises where stored. As such, this material can be defined as "Household Waste" as defined in 40 CFR Part 261.4 (b) (1).

GENERATOR CERTIFICATION

By signing this profile sheet, the Generator certifies:

1. This waste is not a "Hazardous Waste" as defined by USEPA or State of Maine Regulations.
2. The portions of this sheet and attachments contain true and accurate descriptions of the waste material. All revelant information regarding known or suspected hazards in the possession of the Generator has been disclosed.
3. The analytical data presented herein or attached hereto were derived from testing a representative sample taken in accordance with 40 CFR 261.20(c), or equivalent rules.
4. If any changes occur in the character of the waste, the Generator shall notify ARC prior to providing the waste to ARC.

SIGNATURE: Mark Coppola TITLE: Trustee of World 115 Nominee Trust

NAME (print or type): Mark Coppola

P.O. Box 363 • Eliot, ME 03903
Phone 207-439-5584 • N.E. 800-639-7303 • Fax 207-439-5586

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012A

BILL OF LADING (pursuant to 310 CMR 40.0060)

Release Tracking Number*: 3 - 23606

A. LOCATION OF SITE OR DISPOSAL SITE WHERE REMEDIATION WASTE WAS GENERATED:

Release Name (optional):

Street: 515 Somerville Avenue Location Aid:

City/Town: Somerville ZIP Code: 02143-0000

Date/Period of Generation: June 11, 2009 to: June 12,2009

Additional Release Tracking Numbers Associated with this Bill of Lading:

*Note: If this Bill of Lading is the result of a Limited Removal Action (LRA) taken prior to Notification, a Release Tracking Number is not needed.

B. PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH BILL OF LADING:

Name of Organization: World 115 Mowinee Trust

Name of Contact: Mark Coppola Title: Trustee

Street: 127A Watertown Street

City/Town: Newton State: MA ZIP Code: 02459-0000

Telephone: (617) 969-4154 Ext.

C. RELATIONSHIP TO RELEASE OF PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH BILL OF LADING:

☑ RP or PRP Specify: ☐ Owner ☐ Operator ☐ Generator ☐ Transporter Other RP or PRP: Eligible Person, defined by M.G.L. Chpy. 21E, s.2

☐ Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ Other Person:

If an owner and/or operator is not conducting the response action associated with this Bill of Lading, provide on an attachment the name, contact person, address and telephone number, including any area code and extension, for each, if known.

D. TRANSPORTER OR COMMON CARRIER INFORMATION:

Transporter/Common Carrier Name: Removal Specialists

Contact Person: Shawn P. Clarke, Sr. Title: President

Street: PO Box 8069

City/Town: Lynn State: MA ZIP Code: 01904

Telephone: (781) 593-0666 Ext.:

E. RECEIVING FACILITY/TEMPORARY STORAGE LOCATION:

Operator/Facility Name: Aggregate Recycling Corporation

Contact Person: John Doherty Title: CEO

Street: 436 Dow Highway

City/Town: Eliot State: ME ZIP Code: 03903

Telephone: 781-341-5580 Ext.:

Type of Facility: (check one)
☑ Asphalt Batch/Cold Mix ☐ Landfill/Disposal ☐ Incinerator ☐ Temporary Storage
☐ Asphalt Batch/Hot Mix ☐ Landfill/Daily Cover ☐ Other:
☐ Thermal Processing ☐ Landfill/Structural Fill

EPA Identification #:

Division of Hazardous Waste/Class A Permit #: Division of Solid Waste Management Permit #: S021818WCRM

Actual/Anticipated Period of Temporary Storage (specify dates if applicable): to:

Reason for Temporary Storage:

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BILL OF LADING (pursuant to 310 CMR 40.0058)

BWSC-812A

Release Tracking Number: 3 - 23606

E. RECEIVING FACILITY/TEMPORARY STORAGE LOCATION (continued):

Temporary Storage Address:

Street: _____

City/Town: _____ State: _____ ZIP Code: _____

F. DESCRIPTION OF REMEDIATION WASTE:
(check all that apply)

☐ Contaminated Media (check all that apply): ○ Soil ○ Groundwater ○ Surface Water ○ Other: _____

☐ Contaminated Debris (check all that apply): ○ Vegetation or Organic Debris ○ Demolition/Construction Waste
○ Inorganic Absorbent Materials ○ Other: _____

☐ Non-hazardous Uncontainerized Waste (check all that apply): ○ Non-aqueous Phase Liquid ○ Other: _____

☑ Non-hazardous Containerized Waste (check all that apply): ⊘ Tank Bottoms/Sludges ○ Containers ○ Drums
○ Engineered Impoundments ○ Other: _____

Type of Contamination (check all that apply): ☑ Gasoline ☐ Diesel Fuel ☐ #2 Oil ☐ #4 Oil ☐ #6 Oil ☐ Waste Oil
☐ Kerosene ☐ Jet Fuel ☐ Other: _____

Estimated Volume of Materials: Cubic Yards: _____ Tons: _____ Other: _____

Contaminant Source (check one/specify): ☐ Transportation Accident ☐ Underground Storage Tank ☐ Other: _____

Response Action Associated with Bill of Lading (check one): ☐ Immediate Response Action ☑ Release Abatement Measure
☐ Utility-Related Abatement Measure ☐ Limited Removal Action ☐ Comprehensive Response Action ☐ Other _____

Remediation Waste Characterization Support Documentation attached:
☐ Site History Information ☐ Sampling and Analytical Methods and Procedures ☑ Laboratory Data ☐ Field Screening Data

If supporting documentation is not appended, provide an attachment stating the date and in connection with what document such information was previously submitted to DEP.

G. LICENSED SITE PROFESSIONAL (LSP) OPINION:

Name of Organization: Beaman, Wood & Associates, Inc.

LSP Name: Duncan W. Wood Title: Principal

Telephone: (978) 577-1019 Ext. _____

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this submittal, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of

(i) the standard of care in 309 CMR 4.02(1),
(ii) the applicable provisions of 309 CMR 4.03(3) and (3), and
(iii) the provisions of 309 CMR 4.03(5),

to the best of my knowledge, information and belief, the assessment actions undertaken to characterize the Remediation Waste which is (are) the subject of this submittal for acceptance at the facility identified in this submittal comply with the applicable provisions of 310 CMR 40.0060, and such facility is permitted to accept Remediation Waste having the characteristics described in this submittal. I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

LSP Signature: _____ Seal:

Date: August 12, 2009

License Number: 6765

COMMONWEALTH OF MASSACHUSETTS
DUNCAN W. WOOD
No. 6765
REGISTERED
LICENSED SITE PROFESSIONAL

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012A

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number*
5 - 22606

H. CERTIFICATION OF PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH THIS BILL OF LADING:

I certify under penalties of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

Signature: Mark Coppola Date: 8/12/09

Name of Person (print): Mark Coppola

Massachusetts Department of Environmental Protection BWSC-012B
Bureau of Waste Site Cleanup

BILL OF LADING (pursuant to 310 CMR 40.0030)

SUMMARY SHEET 1 OF 1

Release Tracking Number: 3-23606

I. LOAD INFORMATION:

Load 1:
Signature of Transporter Representative:
Date of Shipment: 8-31-09
Time of Shipment: 9:01 ☒ AM ☐ PM
Truck/Tractor Registration: #54
Trailer Registration (if any): N/A

Receiving Facility/Temporary Storage Representative:
Date of Receipt: 8/31/09
Time of Receipt: 10:08 ☒ AM ☐ PM
Load Size (cu. yds./tons): 14.49

Load 2:
Signature of Transporter Representative:
Date of Shipment:
Time of Shipment: ☐ AM ☐ PM
Truck/Tractor Registration:
Trailer Registration (if any):

Receiving Facility/Temporary Storage Representative:
Date of Receipt:
Time of Receipt: ☐ AM ☐ PM
Load Size (cu. yds./tons):

Load 3:
Signature of Transporter Representative:
Date of Shipment:
Time of Shipment: ☐ AM ☐ PM
Truck/Tractor Registration:
Trailer Registration (if any):

Receiving Facility/Temporary Storage Representative:
Date of Receipt:
Time of Receipt: ☐ AM ☐ PM
Load Size (cu. yds./tons):

Load 4:
Signature of Transporter Representative:
Date of Shipment:
Time of Shipment: ☐ AM ☐ PM
Truck/Tractor Registration:
Trailer Registration (if any):

Receiving Facility/Temporary Storage Representative:
Date of Receipt:
Time of Receipt: ☐ AM ☐ PM
Load Size (cu. yds./tons):

Load 5:
Signature of Transporter Representative:
Date of Shipment:
Time of Shipment: ☐ AM ☐ PM
Truck/Tractor Registration:
Trailer Registration (if any):

Receiving Facility/Temporary Storage Representative:
Date of Receipt:
Time of Receipt: ☐ AM ☐ PM
Load Size (cu. yds./tons):

Load 6:
Signature of Transporter Representative:
Date of Shipment:
Time of Shipment: ☐ AM ☐ PM
Truck/Tractor Registration:
Trailer Registration (if any):

Receiving Facility/Temporary Storage Representative:
Date of Receipt:
Time of Receipt: ☐ AM ☐ PM
Load Size (cu. yds./tons):

J. LOG SHEET VOLUME INFORMATION:

Total Volume Recorded This Page (cu. yds./tons): 14.49
Total Carried Forward (cu. yds./tons): -0-
Total Carried Forward and This Page (cu. yds./tons): 14.49

Revised 10/3/94

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012C

BILL OF LADING (pursuant to 310 CMR 40.0830)

SUMMARY SHEET 1 OF 1

Release Tracking Number: 3 - 23606

K. SUMMARY OF SHIPMENTS:

Date of Shipment:	Date of Receipt:	Number of Loads Shipped:	Daily Volume Shipped (cu. yds./tons):
8/31/09	8/31/09	1	14.49

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-012C

BILL OF LADING (pursuant to 310 CMR 40.0030)

SUMMARY SHEET

Release Tracking Number: 3 - 23606

ONLY COMPLETE ONE COPY OF THIS PAGE AND ATTACH TO THE FINAL COPY OF THE SUMMARY SHEET.

L. ACKNOWLEDGMENT OF RECEIPT OF REMEDIATION WASTE AT RECEIVING FACILITY OR TEMPORARY STORAGE:

Receiving Facility/Temporary Storage Representative (print): John J. Delaerty Title: LEO

Signature: John J. Delaerty Date: 8-31-09

M. ACKNOWLEDGMENT OF SHIPMENT AND RECEIPT OF REMEDIATION WASTE BY PERSON CONDUCTING RESPONSE ACTION ASSOCIATED WITH THIS BILL OF LADING:

I certify under penalties of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

Signature: _____ Date: _____

Name of Person (print): Mark Coppola

AGGREGATE RECYCLING CORP
434 DOW HIGHWAY
PO BOX 363
ELIOT,ME 03903

Ticket No # 90756
Date :08/31/2009
Phone :(207)439-5584
Fax :(207)439-5586

Customer:29-08-09
WORLD 115 NOMINEE TRUST
PO BOX 95825

NEWTON MA,02495

REM 54

SOIL SOIL

Gross: 66520 lb Scale In 10:12
Tare: 37540 lb Scale Out 10:24
Net: 28980 lb
14.490 tn

Weigh Master: ROD

Driver:

Remarks:

Material $	0.0
Delivery $	0.0
Misc $	0.0
Tax $	0.0
Total $	0.

File Copy original mailed to Duncan on 9-14-09.

Cycle Chem

The Environmental Services Source

Date 09/21/10

DISCREPANCY NOTICE

Customer:	GENERAL CHEMICAL 133-138 LELAND ST. FRAMINGHAM MA (wsd)	Work Order:	112568
Generator:	WORLD 115 NOMINEE TRUST 515 SOMERVILLE AVENUE SOMERVILLE MA (957004)	Date Received:	09/09/10

Quality Control procedures performed on the above referenced waste shipment have revealed the following discrepancies with either the acceptance criteria or the Material Profile Sheet that require changing the disposal treatment or the cost.

OFF SPEC

RESPONSE REQUESTED

Waste Name:	GASOLINE	Manifest:	006861042JJK	Line Item:	Page 1 Line 1	
Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]		TBD	55-G DM	TBD	2	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 11.8ppm PCBs, 8.8ppm PCB's .

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

B: Material is TSCA regulated $ TBD

Waste Name:	STODDARD SOLVENT	Manifest:	005691042JJK	Line Item:	Page 1 Line 5		
Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]		TBD	55 G DM	TBD	1	TBD

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 18.3ppm PCBs.

PLEASE CHOOSE:

(A): Material is NOT regulated by TSCA

B: Material is TSCA regulated STSD

Waste Name:	STODDARD SOLVENT	Manifest:	005691042JJK	Line Item:	Page 1 Line 5		
Product Code	Price	New Product Code	New Price	Drum Size	Cost Increase	Quantity	Total
IK	[redacted]	PCST1	[redacted]	55 G DM	[redacted]	1	[redacted]

Discrepancy: Material was not profiled as containing PCBs, but when a sample is analyzed in the laboratory, it was found to contain 268.2ppm PCBs.

PLEASE CHOOSE:

A: Material is NOT regulated by TSCA

(B): Material is TSCA regulated ONLY BECAUSE OF PCB CONCENTRATION. 750 ppm

Total Cost Increase: [redacted] 750

Cycle Chem will process all referenced waste streams and invoice for the listed charges. If no response is received in twenty-four hours, Please authorize the above charges by signing below and faxing back to 888 326 0995 or email.

Mark J. Cyganik — [illegible] Trust — 9/22/2010

Name — Company — Date

BASED ON THE ABSENCE OF OTHER THAN TRACE CONCENTRATIONS OF PCBS IN ANY SOURCE MATERIALS TESTED AND THE ABSENCE OF PROCESSES AT THE FACILITY HANDLING PCBS, TSCA REGULATION DOES NOT APPEAR TO BE APPLICABLE. VARIABILITY IN PCB CONTENT OVER MORE THAN AN ORDER OF MAGNITUDE SUGGESTS THE PCB CONTENT WAS DUE TO CONTRACTOR-PROVIDED CONTAMINATED DRUMS.

For ARC Use Only

GENERATOR'S WASTE PROFILE SHEET

AGGREGATE RECYCLING CORPORATION

A. Generator Information

1. GENERATOR NAME: World 115 Nominee Trust
2. SITE STREET ADDRESS: PO Box 95025
3. SITE CITY, STATE: Newton, MA 02495
4. TECHNICAL CONTACT: Duncan Wood 5. PHONE: 603-415-6162

B. Site Description

1. CURRENT SITE USAGE: Construction site, former commercial laundry and fabric cutting shop
2. PROCESS GENERATING WASTE: Removal of abandoned gasoline tanks

C. Material Description

1. CONTAMINANTS:

VIRGIN PRODUCT

XXX GASOLINE	____ # 6 FUEL OIL	____ LUBE / CUTTING OIL
____ KEROSENE	____ MOTOR OIL	____ JP-4 / JET-A / JET FUEL
____ DIESEL	____ HYDRAULIC FLUID	____ OTHER (EXPLAIN):
____ # 2 FUEL OIL	____ MINERAL OIL	____
____ # 4 FUEL OIL	____ TRANSMISSION OIL	____

[ ] WASTE OIL

2. APPROXIMATE THE AMOUNT OF DEBRIS IN THIS MATERIAL: 10 %
ARC RETAINS THE OPTION OF CHARGING FOR DEBRIS IN EXCESS OF 15% UNLESS PREVIOUS ARRANGEMENTS ARE MADE.

3. HAS THIS SITE REMEDIATION BEEN SUPERVISED BY THE STATE OF MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION?
[ ] YES [XXX] NO

IF YES, PLEASE ATTACH SOIL SHIPMENT LETTER

4. CERTIFICATION - Please initial all appropriate sections:

[MC] I certify that, to the best of my knowledge, the waste material submitted to ARC does not contain regulated quantities of polychlorinated biphenyls, as defined by 40 CFR Part 761.

[MC] I certify that, based on knowledge of the site, the materials submitted to ARC are generated from remedial activities associated with a Petroleum Underground Storage Tank System regulated under 40 CFR Part 280. As such, this material is delisted from regulation under TCLP for Volatile and Semi-Volatile constituents.

[ ] I certify that, based on knowledge of the site, the materials submitted to ARC are generated from remedial activities involving a Petroleum Storage Tank used for the storage of heating oil for consumptive use on the premises where stored. As such, this material can be defined as "Household Waste" as defined in 40 CFR Part 261.4 (b) (1).

GENERATOR CERTIFICATION

By signing this profile sheet, the Generator certifies:

1. This waste is not a "Hazardous Waste" as defined by USEPA or State of Maine Regulations.
2. The portions of this sheet and attachments contain true and accurate descriptions of the waste material. All revelant information regarding known or suspected hazards in the possession of the Generator has been disclosed.
3. The analytical data presented herein or attached hereto were derived from testing a representative sample taken in accordance with 40 CFR 261.20(c), or equivalent rules.
4. If any changes occur in the character of the waste, the Generator shall notify ARC prior to providing the waste to ARC.

SIGNATURE: Mark Coppola TITLE: Trustee of World 115 Nominee Trust

NAME (print or type): Mark Coppola

P.O. Box 363 • Eliot, ME 03903
Phone 207-439-5584 • N.E. 800-639-7303 • Fax 207-439-5586

APPENDIX H

TOXICITY PROFILES

ACENAPHTHENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

January 1994

Prepared by Rosmarie A. Faust, Ph.D., Chemical Hazard Evaluation Group, Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, *, Oak Ridge, Tennessee.

Prepared for OAK RIDGE RESERVATION ENVIRONMENTAL RESTORATION PROGRAM

*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400

Acenaphthene, also known as 1,2-dihydroacenaphthylene or 1,8-ethylenenaphthalene, is a tricyclic aromatic hydrocarbon that occurs in coal tar. It is used as a dye intermediate, in the manufacture of some plastics, and as an insecticide and fungicide (EPA, 1980). Acenaphthene has been detected in cigarette smoke, automobile exhausts, and urban air; in effluents from petrochemical, pesticide, and wood preservative industries (EPA, 1980); and in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990).

No absorption data are available for acenaphthene; however, by analogy to structurally-related polycyclic aromatic hydrocarbons (PAHs), it would be expected to be absorbed from the gastrointestinal tract and lungs (EPA, 1988). The anhydride of naphthalic acid was identified as a urinary metabolite in rats treated orally with acenaphthene (Chang and Young, 1943).

Although a large body of literature exists on the toxicity and carcinogenicity of PAHs, primarily benzo[a]pyrene, toxicity data for acenaphthene are limited. Acenaphthene is irritating to the skin and mucous membranes of humans and animals (Sandmeyer, 1981; Knobloch et al., 1969). Acute toxicity data for animals include oral LD_{50}s of 10 g/kg for rats and 2.1 g/kg for mice (Knobloch et al., 1969) and an intraperitoneal LD_{50} of 600 mg/kg for rats (Reshetyuk et al., 1970). Oral exposure of rats to daily 2-g doses of acenaphthene for 32 days produced peripheral blood changes, mild liver and kidney damage, and pulmonary effects (Knobloch et al., 1969). Subchronic oral exposure to acenaphthene at doses of $\geq$ 350 mg/kg for 90 days produced increased liver weights, hepatocellular hypertrophy, and increased cholesterol levels in mice. Reproductive effects included decreased ovary weights at doses of $\geq$ 350

mg/kg and decreased ovarian and uterine activity as well as smaller and fewer corpora lutea at 700 mg/kg/day (EPA, 1989). Adverse effects on the blood, lungs, and glandular tissues were reported in rats exposed daily to 12 mg/m^3 of acenaphthene for 5 months (Reshetyuk et al., 1970).

A reference dose (RfD) of 6E-1 mg/kg/day for subchronic oral exposure (EPA, 1993a) and 6.E-2 mg/kg/day for chronic oral exposure to acenaphthene (EPA, 1993b) was calculated from a no-observed-adverse-effect level (NOAEL) of 175 mg/kg/day from a 90-day gavage study with mice. The critical effect was hepatotoxicity. Data were insufficient to derive an inhalation reference concentration (RfC) for acenaphthene (EPA, 1993a,b).

No oral bioassays were available to assess the carcinogenicity of acenaphthene. A limited inhalation study in which rats were exposed to 12 mg/m^3 acenaphthene for 5 months and observed an additional 8 months provided no evidence of carcinogenicity (Reshetyuk et al., 1970). The EPA has not assigned a weight-of-evidence classification for carcinogenicity to acenaphthene (EPA, 1993a,b).

Last Updated 10/07/97

ANTHRACENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

November 1991

Prepared by Rosmarie A. Faust, Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division, *.

Prepared for OAK RIDGE RESERVATION ENVIRONMENTAL RESTORATION PROGRAM.

*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400.

Anthracene, also referred to as paranaphthalene or green oil, is a polycyclic aromatic hydrocarbon (PAH) derived from coal tar and is primarily used as an intermediate in the production of dyes. It has also been used in the production of smoke screens. Anthracene is ubiquitous in the environment as a product of incomplete combustion of fossil fuels. Although a large body of literature exists on the toxicity and carcinogenicity of a number of PAHs, toxicity data for anthracene are limited.

Evidence indicates that anthracene is absorbed following oral and dermal exposure. Targets for anthracene toxicity are the skin, hematopoietic system, lymphoid system, and gastrointestinal tract. Adverse dermatologic effects have been observed in humans and animals in conjunction with acute and subchronic exposure to anthracene. In humans, anthracene may cause acute dermatitis with symptoms of burning, itching, and edema. Prolonged dermal exposure produces pigmentation, cornification of skin surface layers, and telangiectasis (Volkova, 1983). Anthracene is photosensitizing, potentiating skin damage elicited by exposure to ultraviolet (UV) radiation (U.S. EPA, 1987; Dayhaw-Barker et al., 1985; Forbes et al., 1976). Hematologic toxicity was observed in patients receiving intraperitoneal injections of anthracene-containing chemotherapeutic agents (Falkson et al., 1985) and in rats exposed to anthracene by oral gavage and by inhalation (Volkova, 1983). Mice receiving subcutaneous injections of anthracene exhibited adverse lymphoid effects (Hoch-Ligeti, 1941). Long-term use of anthracene-containing laxatives produced melanosis of the colon and rectum (Badiali et al., 1985). Human exposure to anthracene has also been associated with headache, nausea, loss of appetite, inflammation of the gastrointestinal tract, slow reactions, and weakness (Volkova, 1983).

A Reference Dose (RfD) of 3 mg/kg/day for subchronic oral exposure and 0.3 mg/kg/day for chronic oral exposure to anthracene was calculated from a no-observed-adverse-effect level (NOAEL) of 1000

mg/kg/day derived from a 90-day gavage study with mice (U.S. EPA, 1989). Data were insufficient to derive an inhalation Reference Concentration (RfC) for anthracene (U.S. EPA, 1991a,b).

Carcinogenicity bioassays with anthracene generally gave negative results. Studies involving oral administration (Druckrey and Schmahl, 1955; Schmahl, 1955) or intrapulmonary implantation in rats (Stanton et al., 1972) or implantation into the brain of rabbits (Russell, 1947) provided no evidence of carcinogenicity. Negative results were also obtained when anthracene was tested in mice by skin application (Wynder and Hoffman, 1959; Pollia, 1939; Kennaway, 1924a,b) and in mouse-skin initiation assays (LaVoie et al., 1979; Scribner, 1973). However, skin application of anthracene followed by exposure to UV radiation or visible light induced a high incidence of skin tumors in mice (Heller, 1950).

Based on no human data and inadequate data from animal bioassays, U.S. EPA (1991a,b) has placed anthracene in weight-of-evidence group D, not classifiable as to human carcinogenicity.

Last Updated 8/29/97

BENZENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

September 1992

Prepared by: Mary Lou Daugherty, M.S., Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division*, , Oak Ridge, Tennessee.

Prepared for OAK RIDGE RESERVATION ENVIRONMENTAL RESTORATION PROGRAM.

*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400.

Benzene is absorbed via ingestion, inhalation, and skin application. Experimental data indicate that animals can absorb up to 95% of oral doses and that humans can absorb up to 80% of inhaled benzene (after 5 minutes of exposure) (Sabourin et al., 1987; Srobova et al., 1950). Humans may absorb benzene vapors through the skin as well as the lungs; of the total dose absorbed by the two routes, an estimated 22-36% enters the body through the skin (Susten, 1985).

Autopsy of a youth who died while sniffing benzene revealed that the chemical was distributed to the urine, stomach, bile, liver, kidney, abdominal fat, and brain (Winek and Collum, 1971). The depots for benzene and its metabolites in animals are similar to those in humans, and in addition, include the fetus and placenta, bone marrow, Zymbal gland, and oral and nasal cavities (Ghantous and Danielsson, 1986; Rickert et al., 1979; Low et al., 1989).

Numerous studies indicate that the metabolism of benzene is required for its toxicity (Kalf et al., 1987). The liver is the main site for the metabolism of benzene; the bone marrow, a minor site (ATSDR, 1992). Phenol, hydroquinone, catechol, and benzene oxide are the major metabolites (Kalf et al, 1987; Snyder, 1987). The metabolite(s) of benzene that are responsible for its toxicity have not been positively identified, but likely candidates include muconaldehyde, quinones, and free radicals generated by oxidizing enzymes (Henderson et al., 1989; Snyder, 1987).

Benzene is eliminated either unchanged in expired air or as metabolites in the urine (ATSDR, 1992). The proportions of the administered dose excreted by each route and the half-times for excretion are dependent on route, dose, and duration of exposure.

Lethal oral doses of benzene are estimated to be 10 mL in humans; oral LD_{50} values for benzene in rats range from 0.93 to 5.96 g/kg (Cornish and Ryan, 1965; Withey and Hall, 1975). These data indicate that benzene is of low acute toxicity (O'Bryan and Ross, 1986).

Limited data show that nonlethal oral doses of benzene can impact the nervous, hematological, and immunological systems. Ingested benzene produces symptoms of neurotoxicity at acute doses of 2 mL for humans and 325 mg/kg for rats (Thienes and Haley, 1972; Clayton and Clayton, 1981; Cornish and Ryan, 1965). A four week exposure of mice to >=8 mg of benzene/kg/day in the drinking water induced the synthesis and catabolism of monoamine neurotransmitters and produced dose-related decreases in red-blood cell parameters and lymphocyte numbers (Hsieh et al., 1988b). Rats and mice that were treated with benzene by gavage for 103 weeks developed a dose-related lymphocytopenia (LOAEL, 25 mg/kg/day) and mice had hyperplasia of the bone marrow and lymphoid depletion of the splenic follicles and thymus (100 mg/kg/day) (Huff et al., 1989).

Inhalation of benzene vapor concentrations of 20,000 ppm for 5-10 minutes can be fatal to humans; death results from central nervous system depression (Clayton and Clayton, 1981). The estimated LC_{50} value for the rat is 13,700 ppm (Drew and Fouts, 1974).

As with orally administered benzene, the targets for nonlethal concentrations of inhaled benzene include the nervous, hematological, and immunological systems. Neurological symptoms in humans may appear at exposure concentrations of 700 ppm (Clayton and Clayton, 1981). In animals, 1 week of exposure to 300 ppm induced behavioral effects (Drew and Fouts, 1974), and one to four weeks of exposure to benzene concentrations ranging from 21-50 ppm suppressed the bone marrow (NOAEL, 10 ppm) (Cronkite et al., 1985; Toft et al., 1982), the cellular immune response (NOAEL, 10 ppm) (Rosenthal and Snyder, 1985), and the humoral immune response (LOAEL, 50 ppm) (Aoyama, 1986).

Subchronic and chronic exposures to benzene vapors induce a progressive depletion of the bone marrow and dysfunction of the hematopoietic system. Early symptoms of bone marrow depression include leukopenia, anemia or thrombocytopenia, or a combination of the three (Snyder, 1984). A group of workers exposed to benzene concentrations of 30 and 150 ppm for 4 months to 1 year had increased incidences of pancytopenia (Aksoy et al., 1971; Aksoy et al., 1972; Aksoy and Erdem, 1978). A group of patients who had been exposed to benzene concentrations of 150 to 650 ppm for 4 months to 15 years exhibited severe blood dyscrasias and eight of the 32 patients died with thrombocytopenic hemorrhage and infection (Aksoy et al., 1972). The human data are supported by animal data showing bone marrow suppression in mice and rats exposed to benzene concentrations ranging from 10 ppm for 24 weeks to 300 ppm for 13 weeks (Baarson et al., 1984; Ward et al., 1985).

Benzene may also have long-term effects on the central nervous system. Workers exposed to benzene for 0.5 to 4 years exhibited EEG changes and atypical sleep activity consistent with neurotoxicity (Kellerova, 1985). Others exposed to benzene concentrations of 210 ppm for 6-8 years had peripheral nerve damage (Baslo and Aksoy, 1982).

In humans, benzene crosses the placenta and is present in the cord blood in amounts equal to those in maternal blood (Dowty et al., 1976); however, studies of the effects of benzene on human reproduction and development have been confounded by the presence of other chemicals in the environment (USAF, 1989). Benzene does produce developmental effects (fetal toxicity, but not malformations) in the offspring of treated animals, mostly at maternally toxic doses (Nawrot and Staples, 1979; Seidenberg et al., 1986; Keller and Snyder, 1988).

Reference doses/concentrations for benzene have not been established. An oral risk assessment for benzene will be reviewed by an EPA work group and an inhalation risk assessment is currently under review (U.S. EPA, 1992a).

Benzene is carcinogenic in humans and animals by inhalation and in animals by the oral route of exposure. Occupational exposure to benzene has been associated mainly with increased incidences of acute myeloblastic or erythroblastic leukemias and chronic myeloid and lymphoid leukemias among workers (Aksoy, 1989). Workers at risk were exposed in one study to 8-hour TWA concentrations ranging from 10 to 100 ppm (Rinsky et al., 1981) and in another to 8-hour TWA concentrations ranging from <2 to >25 ppm (Ott et al., 1978). In a historical prospective mortality study of chemical workers, Yin et al. (1987) described a dose-response relationship between exposure to benzene and lymphatic and hematopoietic cancers, which adds strength to the association between exposure in the workplace and cancer development. Studies in animals have demonstrated an association between oral and inhalation exposure to benzene and the development of a variety of tumors, including lymphoma and carcinomas of the Zymbal gland, oral cavity, mammary gland, ovaries, lung, and skin (Huff et al., 1989; Maltoni et al., 1989). In one study C57Bl/BNL mice had increased incidences of leukemia, lymphoma, and solid tumors after exposure to 300 ppm for only 16 weeks (Cronkite et al., 1985; Cronkite, 1983).

Based on "several studies of increased incidence of nonlymphocytic leukemia from occupational exposure, increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, and some supporting data", benzene has been placed in the EPA weight-of-evidence classification A, human carcinogen (U.S. EPA, 1991a). The oral and inhalation slope factors for benzene are 2.9E-2 $(mg/kg/day)^{-1}$ and the oral and inhalation unit risk values are 8.3E-7 and 8.3E-6, respectively, based on the studies of Ott et al. (1978), Rinsky et al. (1981), and Wong et al. (1983) (U.S. EPA, 1992a,b).

Last Updated 02/13/98

BENZO[A]ANTHRACENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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Benz[*a*]anthracene, along with a number of other polycyclic aromatic hydrocarbons, are natural products produced by the incomplete combustion of organic material. The arrangement of the aromatic rings in the benz[*a*]anthracene molecule gives it a "bay region" often correlated with carcinogenic properties. In general, the bay-region polycyclic aromatic hydrocarbons and some of their metabolites are known to react with cellular macromolecules, including DNA, which may account for both their toxicity and carcinogenicity. The inducible mixed-function oxidase enzymes oxidize benz[*a*]anthracene to form metabolites with increased water solubility that can be efficiently excreted in the urine. A minor product of this oxidation, a bay-region diol epoxide, reacts readily with DNA and has been shown to be highly carcinogenic (U.S. EPA, 1980; 1984; Jerina, et al., 1977).

The toxic effects of benz[*a*]anthracene and similar polycyclic aromatic hydrocarbons are primarily directed toward tissues that contain proliferating cells. Animal studies indicate that exposure to bay-region polycyclic aromatic hydrocarbons can damage the hematopoietic system leading to progressive anemia as well as agranulocytosis (Robinson, et al., 1975; Cawein and Sydnor, 1968). The lymphoid system can also be affected resulting in lymphopenia. Toxic effects have been observed in the rapidly dividing cells of the intestinal epithelium, spermatogonia and resting spermatocytes in the testis and primary oocytes of the ovary (Philips et al., 1973; Mackinzie and Angevine, 1981; Kraup, 1970; Ford and Huggins, 1963; Mattison and Thorgeirsson, 1977; U.S. EPA, 1980; 1984). Most of these effects have occurred following both oral and parenteral exposure. Epithelial proliferation and cell hyperplasia in the respiratory tract have been reported following subchronic inhalation exposure (Reznik-Schuller and Mohr, 1974; Saffiotti et al., 1968). However, because of the lack of quantitative data, neither a reference dose nor a reference concentration have been derived (U.S. EPA, 1991).

The primary concern with benz[*a*]anthracene exposure is its potential carcinogenicity. There is no unequivocal, direct evidence of the carcinogenicity of the compound to humans, however, benz[*a*]anthracene and other known carcinogenic polycyclic aromatic hydrocarbons are components of coal tar, soot, coke oven emissions and tobacco smoke. There is adequate evidence of its carcinogenic properties in animals. Oral exposures of mice to benz[*a*]anthracene have resulted in hepatomas, pulmonary adenomas and forestomach papillomas (Klein, 1963; Bock and King, 1959; U.S. EPA, 1991). The EPA weight-of-evidence classification is: B2, probable human carcinogen, for both oral and inhalation exposure based on adequate animal evidence and no human evidence (U.S. EPA, 1991). A slope factor has not been derived specifically for benz[*a*]anthracene by the EPA (U.S. EPA, 1991). However, an oral slope factor of 7.3 $(mg/kg/day)^{-1}$ has been calculated for benzo[*a*]pyrene based on the incidence of stomach tumors in mice treated with benzo[*a*]pyrene (Neal and Rigdon, 1967; U.S. EPA, 1980; 1984; 1992a). A drinking water unit risk of 2.1E-4 $(g/L)^{-1}$ has also been calculated for benzo[*a*]pyrene (U.S. EPA, 1992a). An inhalation slope factor of 6.1 $(mg/kg/day)^{-1}$ (U.S. EPA, 1992b) was calculated for benzo[*a*]pyrene based on the incidence of respiratory tumors in golden hamsters treated with benzo[*a*]pyrene (Thyssen et al., 1981; U.S. EPA, 1980; 1984). An inhalation unit risk of 1.7E-3 $(g/m^3)^{-1}$ has also been calculated for benzo[*a*]pyrene (U.S. EPA, 1992b).

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BENZO[A]PYRENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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Benzo[*a*]pyrene is a polycyclic aromatic hydrocarbon (PAH) that can be derived from coal tar. Benzo[*a*]pyrene occurs ubiquitously in products of incomplete combustion of fossil fuels and has been identified in ambient air, surface water, drinking water, waste water, and char-broiled foods (IARC, 1983). Benzo[*a*]pyrene is primarily released to the air and removed from the atmosphere by photochemical oxidation and dry deposition to land or water. Biodegradation is the most important transformation process in soil or sediment (ATSDR, 1990).

Benzo[*a*]pyrene is readily absorbed following inhalation, oral, and dermal routes of administration (ATSDR, 1990). Following inhalation exposure, benzo[*a*]pyrene is rapidly distributed to several tissues in rats (Sun et al., 1982; Weyand and Bevan, 1986). The metabolism of benzo[*a*]pyrene is complex and includes the formation of a proposed ultimate carcinogen, benzo[*a*]pyrene 7,8 diol-9,10-epoxide (IARC, 1983). The major route of excretion is hepatobiliary followed by elimination in the feces (EPA, 1991).

No data are available on the systemic (non-carcinogenic) effects of benzo[*a*]pyrene in humans. In mice, genetic differences appear to influence the toxicity of benzo[*a*]pyrene. Subchronic dietary administration of 120 mg/kg benzo[*a*]pyrene for up to 180 days resulted in decreased survival due to hematopoietic effects (bone narrow depression) in a "nonresponsive" strain of mice (i.e., a strain whose cytochrome P-450 mediated enzyme activity is not induced as a consequence of PAH exposure). No adverse effects were noted in "responsive" mice (i.e., a strain capable of inducing increased cytochrome P-450 mediated enzyme activity as a consequence of PAH exposure) (Robinson et al., 1975). Immunosuppression has been reported in mice administered daily intraperitoneal injections of 40 or 160 mg/kg of benzo[*a*]pyrene for 2 weeks, with more pronounced effects apparent in "nonresponsive" mice (Blanton et al., 1986; White

et al., 1985). In utero exposure to benzo[*a*]pyrene has produced adverse developmental/reproductive effects in mice. Dietary administration of doses as low as 10 mg/kg during gestation caused reduced fertility and reproductive capacity in offspring (Mackenzie and Angevine, 1981), and treatment by gavage with 120 mg/kg/day during gestation caused stillbirths, resorptions, and malformations (Legraverend et al., 1984). Similar effects have been reported in intraperitoneal injection studies (ATSDR, 1990). Neither a reference dose (RfD) nor a reference concentration (RfC) has been derived for benzo[*a*]pyrene.

Numerous epidemiologic studies have shown a clear association between exposure to various mixtures of PAHs containing benzo[*a*]pyrene (e.g., coke oven emissions, roofing tar emissions, and cigarette smoke) and increased risk of lung cancer and other tumors. However, each of the mixtures also contained other potentially carcinogenic PAHs; therefore, it is not possible to evaluate the contribution of benzo[*a*]pyrene to the carcinogenicity of these mixtures (IARC, 1983; EPA, 1991). An extensive data base is available for the carcinogenicity of benzo[*a*]pyrene in experimental animals. Dietary administration of benzo[*a*]pyrene has produced papillomas and carcinomas of the forestomach in mice (Neal and Rigdon, 1967), and treatment by gavage has produced mammary tumors in rats (McCormick et al., 1981) and pulmonary adenomas in mice (Wattenberg and Leong, 1970). Exposure by inhalation and intratracheal instillation has resulted in benign and malignant tumors of the respiratory and upper digestive tracts of hamsters (Ketkar et al., 1978; Thyssen et al., 1981). Numerous topical application studies have shown that benzo[*a*]pyrene induces skin tumors in several species, although mice appear to be the most sensitive species. Benzo[*a*]pyrene is a complete carcinogen and also an initiator of skin tumors (IARC, 1973; EPA, 1991). Benzo[*a*]pyrene has also been reported to induce tumors in animals when administered by other routes, such as intravenous, intraperitoneal, subcutaneous, intrapulmonary, and transplacental.

Based on United States Environmental Protection Agency (EPA) guidelines, benzo[*a*]pyrene was assigned to weight-of-evidence group B2, probable human carcinogen. For oral exposure, the slope factor and unit risk are 7.3E+0 $(mg/kg/day)^{-1}$ and 2.1E-4 $(ug/L)^{-1}$, respectively (EPA, 1994).

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BENZO[B]FLUORANTHENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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Benzo[*b*]fluoranthene, a crystalline solid with a chemical formula of $C_{20}H_{12}$ and a molecular weight of 252.32 (Lide, 1991), is a polycyclic aromatic hydrocarbon (PAH) with one five-membered ring and four six-membered rings. There is no commercial production or known use of this compound (IARC, 1983). Benzo[*b*]fluoranthene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It has been detected in mainstream cigarette smoke; urban air; gasoline engine exhaust; emissions from burning coal and from oil-fired heating; broiled and smoked food; oils and margarine (IARC, 1983); and in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990).

No absorption data were available for benzo[*b*]fluoranthene; however, by analogy to structurally-related PAHs, primarily benzo[*a*]pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (EPA, 1991). Major metabolites of benzo[*b*]fluoranthene formed in vitro in rat liver include dihydrodiols and monohydroxy derivatives (Amin et al., 1982) and monohydroxy derivatives in mouse epidermis (Geddie et al., 1987).

No data were found concerning the acute, subchronic, chronic, developmental, or reproductive toxicity of benzo[*b*]fluoranthene. No data were available for the derivation of an oral reference dose (RfD) or inhalation reference concentration (RfC) (EPA, 1994).

No long-term oral or inhalation bioassays were available to assess the carcinogenicity of benzo[*b*]fluoranthene. Benzo[*b*]fluoranthene was tested for carcinogenicity in dermal application, lung implantation, subcutaneous (s.c.) injection, and intraperitoneal (i.p.) injection studies. Dermal applications of 0.01-0.5% solutions of benzo[*b*]fluoranthene for life produced a high incidence of skin papillomas and carcinomas in mice (Wynder and Hoffmann, 1959). In initiation-promotion assays, the compound was active as an initiator of skin carcinogenesis in mice (LaVoie et al., 1982; Amin et al., 1985). Sarcomas and carcinomas of the lungs and thorax were seen in rats receiving single lung implants of 0.1-1 mg benzo[*b*]fluoranthene (Deutsch-Wenzel et al., 1983). Newborn mice receiving 0.5 umol benzo[*b*]fluoranthene via i.p. injection developed liver and lung tumors (LaVoie et al., 1987), and mice administered three s.c. injections of 0.6 mg benzo[*b*]fluoranthene developed injection site sarcomas (IARC, 1993).

Based on no human data and sufficient evidence for carcinogenicity in animals, EPA has assigned a weight-of-evidence classification of B2, probable human carcinogen, to benzo[*b*]fluoranthene (EPA, 1994).

Last Updated 8/29/97

BENZO[K]FLUORANTHENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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Benzo[*k*]fluoranthene, a crystalline solid with a chemical formula of $C_{20}H_{12}$ and a molecular weight of 252.32 (Lide, 1991), is a polycyclic aromatic hydrocarbon (PAH) with one five-membered and four six-membered rings. There is no commercial production or known use of this compound (IARC, 1983). Benzo[*k*]fluoranthene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion (IARC, 1983) and in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990).

No absorption or excretion data were available for benzo[*k*]fluoranthene; however, by analogy to structurally-related PAHs, primarily benzo[*a*]pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (EPA, 1991). Rat liver microsomes have been shown to metabolize benzo[*k*]fluoranthene to the dihydrodiol, 8,9-dihydro-8,9-dihydroxy benzo[*k*]fluoranthene (LaVoie et al., 1980).

No data were found concerning the acute, subchronic, chronic, developmental, or reproductive toxicity of benzo[*k*]fluoranthene. Because of a lack of toxicity data, an oral reference dose (RfD) or inhalation reference concentration (RfC) have not been derived (EPA, 1994).

No long-term oral or inhalation bioassays were available to assess the carcinogenicity of benzo[*k*]fluoranthene. Benzo[*k*]fluoranthene was tested for carcinogenicity in dermal application, subcutaneous (s.c.) injection, lung implantation, and intraperitoneal (i.p.) injection studies. Dermal applications of 0.5% solutions of benzo[*k*]fluoranthene for life produced only a few skin papillomas in mice (Wynder and Hoffmann, 1959), but in initiation-promotion assays, benzo[*k*]fluoranthene was active

as an initiator of skin carcinogenesis (LaVoie et al., 1982; Amin et al., 1985). Injection site sarcomas developed in mice given three s.c. injections of 0.6 mg benzo[*k*]fluoranthene (Lacassagne et al., 1963) and dose-related increases of epidermoid carcinomas of the lungs were reported in rats receiving single lung implants of 0.16-4.15 mg benzo[*k*]fluoranthene (Deutsch-Wenzel et al., 1983). In a short-term assay, hepatic and lung tumors occurred in newborn mice receiving 2.1 umol benzo[*k*]fluoranthene via i.p. injection (LaVoie et al., 1987).

Based on no human data and sufficient evidence for carcinogenicity in animals, EPA has assigned a weight-of-evidence classification of B2, probable human carcinogen, to benzo[*k*]fluoranthene (EPA, 1994).

Last Updated 8/29/97

BENZO[G,H,I]PERYLENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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Benzo[*g,h,i*]perylene, also known as 1,12-benzoperylene, is a polycyclic aromatic hydrocarbon (PAH) with six aromatic rings. There is no known commercial production or use of benzo[*g,h,i*]perylene. It occurs naturally in crude oils and is present ubiquitously in products of incomplete combustion and in coal tar (EPA, 1987).

No absorption data were available for benzo[*g,h,i*]perylene; however, by analogy to other PAHs, primarily benzo[*a*]pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (EPA, 1991).

No human or animal data were available to evaluate the toxicity of benzo[*g,h,i*]perylene. Because of the lack of data, EPA has not derived an oral reference dose (RfD) or inhalation reference concentration (RfC) (EPA, 1992).

No oral or inhalation bioassays were available to assess the carcinogenicity of benzo[*g,h,i*]perylene. Negative results were reported in dermal application studies (Hoffmann and Wynder, 1966; Van Duuren and Goldschmidt, 1976) and in initiation-promotion assays for skin tumorigenesis in mice (Hoffmann and Wynder, 1966; Van Duuren et al., 1970). However, when benzo[*g,h,i*]perylene was administered simultaneously with benzo[*a*]pyrene to the skin of mice, an increased incidence of skin tumors was observed compared to the tumor incidence in mice treated with benzo[*a*]pyrene alone, indicating possible cocarcinogenic activity of benzo[*g,h,i*]perylene (Van Duuren et al., 1973). Although a few pulmonary tumors were observed in Osborne-Mendel rats when benzo[*g,h,i*]perylene was administered as single lung implants of >=83 mg (Deutsch-Wenzel et al., 1983), the tumors may have been caused by impurities in

the test compound (IARC, 1983). In subcutaneous injection studies, benzo[*g,h,i*]perylene did not produce injection site tumors in mice (Muller, 1968).

Based on no human data and inadequate data with experimental animals, the United States Environmental Protection Agency (EPA) has classified benzo[*g,h,i*]perylene in weight-of-evidence Group D, not classifiable as to human carcinogenicity (EPA, 1992).

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CHRYSENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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TOXICITY SUMMARY UPDATE

This report is an update of the Toxicity Summary for Chrysene (CAS Registry No. 218-01-9). The original summary for this chemical was submitted in November 1991. The update was performed by incorporating any new human health toxicity data published since the original submittal of the report. Pertinent pharmacokinetic, toxicologic, carcinogenic, and epidemiologic data were obtained through on-line searches of the TOXLINE database from 1991 through 1994. In addition, any changes to EPA-approved toxicity values (reference doses, reference concentrations, or cancer slope factors) from the Integrated Risk Information System (IRIS) (current as of December 1994) and/or the Health Effects Assessment Summary Tables, Annual FY-94 and July Supplement No. 1, for this chemical were incorporated in this update.

Chrysene, a polycyclic aromatic hydrocarbon, is a ubiquitous environmental contaminant formed primarily by the incomplete combustion of organic compounds. Although present in coal and oil, the presence of chrysene in the environment is the result of anthropogenic activities such as coal combustion and gasification; gasoline exhaust; diesel and aircraft exhaust; and emissions from coke ovens, wood burning stoves, and waste incineration (IARC, 1983; ATSDR, 1990). Chrysene is not produced or used commercially, and its use is limited strictly to research applications.

Little information on the absorption, distribution, metabolism and excretion of chrysene in humans is available. Animal studies have shown that approximately 75% of the administered chrysene may be absorbed by oral, dermal, or inhalation routes (Grimmer et al., 1988; Modica et al., 1983; Chang, 1943). Following its absorption, chrysene is preferentially distributed to highly lipophilic regions of the body, most notably adipose and mammary tissue (Bartosek et al., 1984; Modica et al., 1983). Phase I metabolism of chrysene, whether in the lung, skin, or liver, is mediated by the mixed function oxidases. The metabolism results in the formation of 1,2-, 3,4-, and 5,6-dihydrodiols as well as the formation of 1-, 3-, and 4-phenol metabolites (Sims, 1970; Nordquist et al., 1981; Jacob et al., 1982, 1987). Additional Phase I metabolism of chrysene 1,2-dihydrodiol forms chrysene 1,2-dihydrodiol-3,4-epoxide and 9-hydroxychrysene 1,2-diol-3,4-oxide. These metabolites were shown to have mutagenic and alkylating activity (Hodgson et al., 1983; Wood et al., 1977; Wood et al., 1979). Phase II metabolism of chrysene results in the formation of glucuronide and sulfate ester conjugates; however, glutathione conjugates of diol- and triol-epoxides are also formed (Sims and Grover, 1974, 1981; Hodgson et al., 1986; Robertson and Jernström, 1986). Hepatobiliary secretion with elimination in the feces is the predominant route of excretion (Schlede et al., 1970; Grimmer et al., 1988).

Human or animal systemic, developmental, and reproductive health effects following exposure to chrysene were not identified. Because of the lack of systemic toxicity data, the reference dose (RfD) and the reference concentration (RfC) for chrysene have not been derived (EPA, 1994a, b). Target organs have not been described, although chrysene may induce immunosuppression similar to certain other PAHs. Oral and inhalation carcinogenic bioassays were not identified. In mouse skin painting studies, chrysene was an initiator of papillomas and carcinomas. In addition, intraperitoneal injections of chrysene have induced liver adenomas and carcinomas in male CD-1 and BLU/Ha Swiss mice. Although oral and inhalation slope factors have not been derived, EPA (1994a,b) has classified chrysene in weight-of-evidence Group B2, probable human carcinogen, based on the induction of liver tumors and skin papillomas and carcinomas following treatment and the mutagenicity and chromosomal abnormalities induced in in vitro tests.

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DIBENZ[A,H]ANTHRACENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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Dibenz[*a,h*]anthracene is a polycyclic aromatic hydrocarbon (PAH) with five aromatic rings. No commercial production or use of dibenz[*a,h*]anthracene is known. It occurs as a component of coal tars, shale oils, and soots (IARC, 1985) and has been detected in gasoline engine exhaust, coke oven emissions, cigarette smoke, charcoal broiled meats, vegetation near heavily traveled roads, and surface water and soils near hazardous waste sites (ATSDR, 1993; IARC, 1983).

Dibenz[*a,h*]anthracene is poorly absorbed from the gastrointestinal tract and is primarily excreted via feces (Chang, 1943). Following absorption, dibenz[*a,h*]anthracene is distributed to various tissues, with highest accumulation in the liver and kidneys (Daniel et al., 1967). Dibenz[*a,h*]anthracene is metabolized by mixed function oxidases to dihydrodiols. Epoxidation of the 3,4-dihydrodiol may lead to the formation of a diol-epoxide, the putative ultimate carcinogenic metabolite of dibenz[*a,h*]anthracene (Buening et al., 1979).

No human studies were available to evaluate the toxicity of dibenz[*a,h*]anthracene. In animals, depressed immune responses were observed in mice following single or multiple subcutaneous injections of dibenz[*a,h*]anthracene (White et al., 1985). Weekly subcutaneous. injections of 0.05% dibenz[*a,h*]anthracene for 40 weeks produced lymphoid tissue changes, decreased spleen weights, and liver and kidney lesions in mice (Hoch-Ligeti, 1941). Weekly intramuscular injections of 20 mg/kg promoted the development of arteriosclerotic plaques in chickens (Penn and Snyder, 1988).

The EPA has not derived an oral reference dose (RfD) or inhalation reference concentration (RfC) for dibenz[*a,h*]anthracene (EPA, 1995).

No epidemiologic studies or case reports addressing the carcinogenicity of dibenz[*a,h*]anthracene in humans were available. In animals, dibenz[*a,h*]anthracene has produced tumors by different routes of administration, having both local and systemic carcinogenic effects.

After oral administration, dibenz[*a,h*]anthracene produced tumors at several sites. Male and female mice fed dibenz[*a,h*]anthracene (0.85 mg/day for males, 0.76 mg/day for females) in an aqueous olive oil emulsion developed pulmonary adenomatosis, alveologenic carcinomas of the lung, hemangio-endotheliomas of the pancreas and mesentery/abdominal lymph nodes, and mammary carcinomas (females) after 200 days (Snell and Stewart, 1962). A single oral dose of 1.5 mg dibenz[*a,h*]anthracene in polyethylene glycol produced a low incidence of forestomach papillomas in mice (Berenblum and Haran, 1955). Mammary carcinomas developed in mice treated by gavage with a total dose of 15 mg over a 15-week period (Biancifiori and Caschera, 1962).

Carcinogenic as well as tumor-initiating activity of dibenz[*a,h*]anthracene has been demonstrated in topical application studies with mice. Repeated dermal application of 0.001 to 0.01% solutions produced a high incidence of skin papillomas and carcinomas in mice (Wynder and Hoffmann, 1959; Van Duuren et al., 1967). In initiation-promotion assays, the compound was active as an initiator of skin carcinogenesis in mice (Buening et al., 1979; Platt et al., 1990). However, no skin tumors were observed in Syrian golden hamsters that received topical dibenz[*a,h*]anthracene applications over a 10-week period (Shubik et al., 1960).Injection site sarcomas developed in mice injected subcutaneously with dibenz[*a,h*]anthracene (Pfeiffer, 1977). In newborn mice, a single subcutaneous injection of dibenz[*a,h*]anthracene induced local sarcomas and lung adenomas (Platt et al., 1990) and three intraperitoneal injections induced a high incidence of pulmonary tumors (Buening et al., 1979). A number of earlier studies have also demonstrated the carcinogenicity of dibenz[*a,h*]anthracene when administered by various parenteral routes in several animal species (IARC, 1973).

Based on no human data and sufficient evidence for carcinogenicity in animals, EPA has assigned dibenz[*a,h*]anthracene a weight-of-evidence classification of B2, probable human carcinogen (EPA, 1995).

Last Updated 10/07/97

ETHYLBENZENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

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Ethylbenzene is a colorless, flammable liquid with a pungent odor (Cavender 1994). The water solubility of ethylbenzene is 0.014 g/100 mL and its vapor pressure is 10 mm Hg at 25C (Budavari et al. 1989). Ethylbenzene is commonly used as a solvent, chemical intermediate in the manufacture of styrene and synthetic rubber and as an additive in some automotive and aviation fuels (Cavender 1994). Occupational exposure to ethylbenzene may occur during production and conversion to polystyrene and during production and use of mixed xylenes (Fishbein 1985). The general public can be exposed to ethylbenzene in ambient air as a result of releases from vehicle exhaust and cigarette smoke (Fishbein 1985).

Ethylbenzene can be absorbed through the lungs, digestive tract, and skin (Fishbein 1985). It also crosses the placenta (Cavender 1994). The liver is the major organ of ethylbenzene metabolism. In humans the major metabolites of ethylbenzene are mandelic acid (64 to 70%) and phenylglyoxylic acid (25%) (Bardodej and Bardodejova 1970, Fishbein 1985, Cavender 1994); however, these compounds are only minor metabolites in laboratory animals (EPA 1995). Excretion occurs primarily in the urine (NTP 1992, Climie et al. 1983).

Ingestion of sublethal amounts of ethylbenzene is likely to cause central nervous system (CNS) depression, oro-pharyngeal and gastric discomfort, and vomiting (HSDB 1995); however, specific experimental data are not available. Animal studies indicate that the primary target organs following chronic oral exposures are likely to be the liver and kidney. The oral RfD for chronic exposures is 0.1 mg/kg/day, based on increased weight and histopathological changes in the liver and kidneys of rats (EPA 1996).

Acute exposures to high atmospheric concentrations of ethylbenzene may cause eye and respiratory tract irritation and CNS effects (e.g., coordination disorders, dizziness, vertigo, narcosis, convulsions,

pulmonary irritation, and conjunctivitis) (Ivanov 1962). Concentrations of 1000 ppm (434 mg/m^3) can be highly irritating to the eyes of humans (Yant et al. 1930); the threshold for eye irritation has been reported to be 200 ppm (879 mg/m^3) (Grabt 1986). No evidence is available to suggest that occupational exposures to ethylbenzene result in chronic toxic effects (Fishbein 1985); however, histopathological changes in the liver and kidney have been observed in experimental animals following prolonged inhalation exposures. Laboratory studies also indicate that exposure to ethylbenzene (4340 mg/m^3) during gestation results in adverse developmental effects in rats (skeletal variants) and rabbits (reduced number of live offspring per litter). The no-observed-adverse-effect level (NOAEL) for developmental effects was reported to be 434 mg/m^3. The inhalation RfC for chronic exposures is 1 mg/m^3, based on developmental effects (EPA 1996).

No epidemiological information is available on the potential carcinogenicity of ethylbenzene in humans following oral or inhalation exposures. A statistically significant increase in total malignant tumors was observed in female rats dosed orally with ethylbenzene (Maltoni et al. 1985); however, because of study limitations, these results cannot be considered conclusive. Although ethylbenzene has been tested by NTP in a two-year rodent bioassay, the results of that study are not yet available (NTP 1995). Ethylbenzene is placed by EPA in Group D, not classifiable as to human carcinogenicity, based on a lack of data in humans and animals (EPA 1996).

FLUORANTHENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

August 1993

Prepared by Rosmarie A. Faust, Ph.D., Chemical Hazard Evaluation and Communication Program, Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, *, Oak Ridge, Tennessee.

Prepared for OAK RIDGE RESERVATION ENVIRONMENTAL RESTORATION PROGRAM.

*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under contract No. DE-AC05-84OR21400.

Fluoranthene is a polycyclic aromatic hydrocarbon (PAH) that can be derived from coal tar. Occurring ubiquitously in products of incomplete combustion of fossil fuels, fluoranthene has been identified in ambient air, surface, drinking, and waste water, and in char-broiled foods. Currently, there is no commercial production or use of this compound (IARC, 1983).

Fluoranthene can be absorbed through the skin following dermal exposure (Storer et al., 1984) and, by analogy to structurally-related PAHs, would be expected to be absorbed from the gastrointestinal tract and lungs (U.S. EPA, 1988). An *in vitro* study identified 2-methylfluoranthene and 3-methylfluoranthene and their dihydrodiols as metabolites of fluoranthene (La Voie et al., 1982).

Although a large body of literature exists on the toxicity and carcinogenicity of PAHs, primarily benzo[*a*]pyrene, toxicity data for phenanthrene are very limited. No human data were available that addressed the toxicity of fluoranthene. Acute toxicity data for animals include an oral LD_{50} of 2000 mg/kg for rats; a dermal LD_{50} of 3180 mg/kg for rabbits (Smyth et al., 1962); and an intravenous LD_{50} of 100 mg/kg for mice (RTECS, 1993). Subchronic oral exposure to fluoranthene at doses of greater than or equal to 250 mg/kg produced nephropathy, increased liver weights, and increased liver enzyme levels in rats (U.S. EPA, 1988). A single intraperitoneal injection of fluoranthene to pregnant rats caused an increased rate of embryo resorptions (Irvin and Martin, 1987). Fluoranthene was photosensitizing, enhancing erythema elicited by ultraviolet radiation in guinea pig skin (Kochevar et al., 1982) and was irritating to the eyes of rabbits (Grant, 1986).

A Reference Dose (RfD) of 4.00E-01 mg/kg/day for subchronic oral exposure and 4.00E-02 mg/kg/day for chronic oral exposure to fluoranthene was calculated from a no-observed-adverse-effect level (NOAEL) of 125 mg/kg/day and a lowest-observed-adverse-effect level (LOAEL) of 250 mg/kg/day derived from a 13-week gavage study with mice (U.S. EPA, 1993a,b). The critical effects were nephropathy, increased liver weights, and changes in clinical and hematological parameters. Data were insufficient to derive an inhalation Reference Concentration (RfC) for fluoranthene (U.S. EPA, 1993a,b).

No oral or inhalation bioassays were available to assess the carcinogenicity of fluoranthene. Bioassays by other exposure routes generally gave negative results. Studies involving topical application to the skin of mice (Horton and Christian, 1974; Hoffmann, 1972; Wynder and Hoffmann, 1959; Suntzeff et al., 1957) and subcutaneous injection in mice (Shear, 1938) provided no evidence of carcinogenicity. Fluoranthene was also inactive in mouse skin initiation and promotion assays (Van Duuren and Goldschmidt, 1976; Hoffmann, et al., 1972). However, fluoranthene has been shown to be active as a cocarcinogen when applied with benzo[*a*]pyrene to mice by skin application (Van Duuren and Goldschmidt, 1976) and was active as a complete carcinogen in a short-term lung tumor assay with newborn mice (Busby et al., 1984).

Based on no human data and inadequate data from animal bioassays, U.S. EPA (1993a,b) has placed fluoranthene in weight-of-evidence group D, not classifiable as to human carcinogenicity.

Last Updated 10/31/97

INDENO[1,2,3-*cd*]PYRENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

MAY 1994

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Prepared for: Oak Ridge Reservation Environmental Restoration Program.

*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400.

Indeno[1,2,3-*cd*]pyrene, a crystalline solid with a chemical formula of $C_{22}H_{12}$ and a molecular weight of 276.3, is a polycyclic aromatic hydrocarbon (PAH). There is no commercial production or known use of this compound (IARC, 1983). Indeno[1,2,3-*cd*]pyrene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion (IARC, 1983) and has been identified in soils, groundwater, and surface waters at hazardous waste sites (ATSDR, 1990).

No absorption data were available for indeno[1,2,3-*cd*]pyrene; however, by analogy to structurally-related PAHs, primarily benzo[*a*]pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (EPA, 1991). In vivo metabolites identified in mouse skin include the *trans*-1,2-dihydrodiol and 8- and 9-hydroxy forms of indeno[1,2,3-*cd*]pyrene (Rice et al., 1986). Similar metabolites were formed in vitro in rat liver microsomes (Rice et al., 1985).

No data were found concerning the acute, subchronic, chronic, developmental, or reproductive toxicity of indeno[1,2,3-*cd*]pyrene. Because of a lack of toxicity data, an oral reference dose (RfD) or inhalation reference concentration (RfC) has not been derived (EPA, 1994).

No long-term oral or inhalation bioassays were available to assess the carcinogenicity of indeno[1,2,3-*cd*]pyrene. The compound was tested for carcinogenicity in dermal application, lung implant, subcutaneous (s.c.) injection, and intraperitoneal (i.p.) injection studies. Dermal application of 0.1-0.5% solutions of indeno[1,2,3-*cd*]pyrene in acetone produced skin papillomas and carcinomas in mice (Hoffmann and Wynder, 1966). In initiation-promotion assays, indeno[1,2,3-*cd*]pyrene was active as an initiator of skin carcinogenesis (Hoffmann and Wynder, 1966; Rice et al., 1986). Dose-related increases

of epidermoid carcinomas of the lungs were reported in rats receiving single lung implants of 0.16-4.15 mg indeno[1,2,3-*cd*]pyrene (Deutsch-Wenzel et al., 1983). Injection site sarcomas developed in mice given three s.c. injections of 0.6 mg indeno[1,2,3-*cd*]pyrene (Lacassagne et al., 1963). The compound was not tumorigenic when newborn mice received 2.1 mol indeno[1,2,3-*cd*]pyrene via i.p. injection (LaVoie et al., 1987).

Based on no human data and sufficient evidence for carcinogenicity in animals, the United Stated Environmental Protection Agency (EPA) has assigned a weight-of-evidence classification of B2, probable human carcinogen, to indeno[1,2,3-*cd*]pyrene (EPA, 1994).

Last Updated 2/13/98

NAPTHALENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

JANUARY 1993

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*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400.

Naphthalene (CAS Reg. No. 91-20-3), a white solid with a characteristic odor of mothballs, is a polycyclic aromatic hydrocarbon composed of two fused benzene rings. The principal end use of naphthalene is as a raw material for the production of phthalic anhydride. It is also used as an intermediate for synthetic resins, celluloid, lampblack, smokeless powder, solvents, and lubricants. Naphthalene is used directly as a moth repellant, insecticide, anthelmintic, and intestinal antiseptic (ATSDR, 1990; U.S. EPA, 1986).

Naphthalene can be absorbed by the oral, inhalation, and dermal routes of exposure and can cross the placenta in amounts sufficient to cause fetal toxicity. The most commonly observed effect of naphthalene toxicity following acute oral or inhalation exposure in humans is hemolytic anemia associated with decreased hemoglobin and hematocrit values, increased reticulocyte counts, presence of Heinz bodies, and increased serum bilirubin levels (ATSDR, 1990). Hemolytic anemia has been observed in an infant dermally exposed to naphthalene (Schafer, 1951) and in infants whose mothers were exposed to naphthalene during pregnancy (Anziulewicz et al., 1959; Zinkham and Childs, 1958). Infants and individuals having a congenital deficiency of erythrocyte glucose-6-phosphate dehydrogenase are especially susceptible to naphthalene-induced hemolytic anemia (Wintrobe et al., 1974).

Acute oral and subchronic inhalation exposure of humans to naphthalene has resulted in neurotoxic effects (confusion, lethargy, listlessness, vertigo), gastrointestinal distress, hepatic effects (jaundice, hepatomegaly, elevated serum enzyme levels), renal effects, and ocular effects (cataracts, optical atrophy). Cataracts have been reported in individuals occupationally exposed to naphthalene (Ghetti and Mariani, 1956) and in rabbits and rats exposed orally to naphthalene (Van Heyningen and Pirie, 1976;

Fitzhugh and Buschke, 1949). A number of deaths have been reported following intentional ingestion of naphthalene-containing mothballs (ATSDR, 1990). The estimated lethal dose of naphthalene is 5-15 g for adults and 2-3 g for children. Naphthalene is a primary skin irritant and is acutely irritating to the eyes of humans (Sandmeyer, 1981).

Increased mortality, clinical signs of toxicity, kidney and thymus lesions, and signs of anemia were observed in rats treated by gavage with 400 mg/kg of naphthalene for 13 weeks (NTP, 1980a). No adverse effects occurred at 50 mg/kg. Transient clinical signs of toxicity were seen in mice exposed by gavage to 53 mg/kg for 13 weeks (NTP, 1980b). Subchronic oral exposure to 133 mg/kg/day for 90 days produced decreased spleen weights in female mice (Shopp et al., 1984). Reduced numbers of pups/litter were observed when naphthalene was administered orally to pregnant mice (Pflasterer et al., 1985). Negative results in a two-year feeding study with rats receiving 10-20 mg naphthalene/kg/day (Schmahl, 1955) and equivocal results in a mouse lung tumor bioassay (Adkins et al., 1986) suggest that naphthalene is not a potential carcinogen.

A subchronic and chronic oral reference dose (RfD) of 4E-2 mg/kg/day for naphthalene has been calculated by U.S. EPA (1992). These values are based on a NOEL of 50 mg/kg/day derived from a subchronic oral toxicity study with rats (NTP, 1980a). The RfD is currently under review by U.S. EPA and may be subject to change (U.S. EPA, 1992). A reference concentration (RfC) for chronic inhalation exposure has not been derived by U.S. EPA. Available cancer bioassays were insufficient to assess the carcinogenicity of naphthalene. Therefore, U.S. EPA (1991, 1992) has placed naphthalene in weight-of-evidence group D, not classifiable as to human carcinogenicity.

Last Updated 2/13/98

PHENANTHRENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

AUGUST 1993

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Prepared for: Oak Ridge Reservation Environmental Restoration Program.

*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under Contract No. DE-AC05-84OR21400.

Phenanthrene is a polycyclic aromatic hydrocarbon (PAH) that can be derived from coal tar. Currently, there is no commercial production or use of this compound (U.S. EPA, 1987). Phenanthrene is ubiquitous in the environment as a product of incomplete combustion of fossil fuels and wood and has been identified in ambient air, surface and drinking water, and in foods (U.S. EPA, 1988; IARC, 1983).

Phenanthrene is absorbed following oral and dermal exposure (Storer et al., 1984; Chang, 1943). Data from structurally related PAHs suggest that phenanthrene would be absorbed from the lungs (U.S. EPA, 1987). Metabolites of phenanthrene identified in *in vivo* and *in vitro* studies indicate that metabolism proceeds by epoxidation at the 1-2, 3-4, and 9-10 carbons, with dihydrodiols as the primary metabolites (Nordqvist et al., 1981; Chaturapit and Holder, 1978; Sims, 1970; Boyland and Sims, 1962; Boyland and Wolf, 1950).

Although a large body of literature exists on the toxicity and carcinogenicity of PAHs, primarily benzo[*a*]pyrene, toxicity data for phenanthrene are very limited. No human data were available that addressed the toxicity of phenanthrene. Single intraperitoneal injections of phenanthrene produced slight hepatotoxicity in rats (Yoshikawa et al., 1985). Data regarding the subchronic, chronic, developmental, or reproductive toxicity in experimental animals by any route of exposure could not be located in the available literature.

Data were insufficient to derive an oral reference dose (RfD) or inhalation reference concentration (RfC) for phenanthrene (U.S. EPA, 1988). The chemical is not currently listed in IRIS or HEAST (U.S. EPA, 1993a,b).

No inhalation bioassays were available to assess the carcinogenicity of phenanthrene. A single oral dose of phenanthrene did not induce mammary tumors in rats (Huggins and Yang, 1962) and a single subcutaneous injection did not result in treatment-related increases in tumor incidence in mice (Steiner, 1955). Neonate mice administered intraperitoneal or subcutaneous injections of phenanthrene also did not develop tumors (Buening et al., 1979). No skin tumors were reported in two skin painting assays with mice (Roe and Grant, 1964; Kennaway, 1924). Phenanthrene was also tested in several mouse skin initiation-promotion assays. It was active as an initiator in one study (Scribner, 1973), inactive as an initiator in four others (LaVoie et al., 1981; Wood et al., 1979; Roe, 1962; Salaman and Roe, 1956), and inactive as a promoter in one study (Roe and Grant, 1964).

Based on no human data and inadequate data from animal bioassays, U.S. EPA (1993a, 1987) has placed phenanthrene in weight-of-evidence group D, not classifiable as to human carcinogenicity.

Last Updated 2/13/98

PYRENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

AUGUST 1993

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Prepared for: Oak Ridge Reservation Environmental Restoration Program.

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Pyrene, also referred to as benzo(def)phenanthrene and -pyrene, is a polycyclic aromatic hydrocarbon (PAH) that can be derived from coal tar. Currently, there is no commercial production or use of this compound. Pyrene is ubiquitous in the environment as a product of incomplete combustion of fossil fuels and has been identified in surface and drinking water, numerous foods, and in ambient air (U.S. EPA, 1988, 1987; IARC, 1983).

Although a large body of literature exists on the toxicity and carcinogenicity of PAHs, toxicity data for pyrene are limited. No human data were available that addressed the toxicity of pyrene. Subchronic oral exposure to pyrene produced nephropathy, decreased kidney weights, increased liver weights, and slight hematological changes in mice (TRL, 1989) and produced fatty livers in rats (White and White, 1939). A single intraperitoneal injection of pyrene produced swelling and congestion of the liver and increased serum aspartate amino transferase (AST) and bilirubin levels in rats (Yoshikawa et al., 1985). No data were available concerning the toxic effects of inhalation exposure to pyrene or data regarding teratogenicity or other reproductive effects by any route of exposure.

A Reference Dose (RfD) of 3E-1 mg/kg/day for subchronic (U.S. EPA, 1993a) and 3E-2 mg/kg/day for chronic oral exposure (U.S. EPA, 1993b) to pyrene was calculated from a no-observed-adverse-effect level (NOAEL) of 75 mg/kg/day in a 13-week gavage study with mice (TRL, 1989). Data were insufficient to derive an inhalation Reference Concentration (RfC) for pyrene (U.S. EPA, 1993a,b).

No oral or inhalation bioassays were available to assess the carcinogenicity of pyrene. Studies involving other routes of exposure (intratracheal, dermal, and subcutaneous) generally gave negative results.

Intratracheal administration of pyrene in combination with Fe_2O_3 particles did not induce tumors in hamsters (Sellakumar and Shubik, 1974). Skin painting assays evaluating complete carcinogenesis in mice (Van Duuren and Goldschmidt, 1976; Horton and Christian, 1974; Roe and Grant, 1964; Wynder and Hoffman, 1959); or initiating (Roe and Grant, 1964); or promoting capacity (Wood et al., 1980; Scribner, 1973; Salaman and Roe, 1956) have been negative or inconclusive. Mice injected subcutaneously with pyrene did not develop tumors (Shear and Leiter, 1941), but there is evidence that pyrene enhances the tumorigenicity of topically applied benzo[*a*]pyrene (Slaga et al., 1979; Van Duuren and Goldschmidt, 1976; Goldschmidt et al., 1973).

Based on no human data and inadequate data from animal bioassays, U.S. EPA (1993a,b) has placed pyrene in weight-of-evidence group D, not classifiable as to human carcinogenicity.

Last Updated 2/13/98

TOLUENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

JANUARY 1994

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Prepared for: Oak Ridge Reservation Environmental Restoration Program.

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Toluene is a colorless liquid widely used as raw material in the production of organic compounds and as a solvent (EPA, 1990). It is readily absorbed from the gastrointestinal and respiratory tracts and, to a lesser degree, through the skin. Toluene is distributed throughout the body, with accumulation in tissues with high lipid content. It is metabolized in the liver, primarily to hippuric acid and benzoyl glucuronide, compounds that are rapidly excreted in the urine (EPA, 1990; ATSDR, 1989).

In humans and animals, the primary effect associated with inhalation exposure to toluene is central nervous system (CNS) depression. Short-term exposure of humans to 100-1500 ppm has elicited CNS effects such as fatigue, confusion, incoordination, and impairments in reaction time, perception, and motor control and function (NTP, 1990). Exposure to concentrations ranging from 10,000-30,000 ppm has resulted in narcosis and deaths (WHO, 1985). Prolonged abuse of toluene or solvent mixtures containing toluene has led to permanent CNS effects. Exposure to high concentrations of toluene (1500 ppm) has produced hearing loss in rats (Pryor et al., 1984). Hepatomegaly and impaired liver and kidney function have been reported in some humans chronically exposed to toluene (Askergren, 1984; Szilard et al., 1978; Greenburg et al., 1942). Toluene vapors may cause eye irritation (Andersen et al., 1983), and prolonged or repeated dermal contact may produce drying of skin and dermatitis (ATSDR, 1989; NIOSH, 1973).

In experimental animals, subchronic inhalation exposure to 2500 ppm toluene resulted in increased liver and kidney weights (rats and mice), increased heart weights (rats), increased lung weights, and centrilobular hypertrophy of the liver (mice) (NTP, 1990). Chronic inhalation exposure to 600 or 1200

ppm for 2 years produced degeneration of olfactory and respiratory epithelia of rats and minimal hyperplasia of bronchial epithelia in mice (NTP, 1990).

Subchronic oral administration of toluene at doses ranging from 312 to 5000 mg/kg/day produced clinical signs of neurotoxicity at 2500 mg/kg in rats and mice. Other effects observed at higher doses in rats included increased relative liver, kidney, and heart weights (females only) and necrosis of the brain and hemorrhage of the urinary bladder (NTP, 1990).

Equivocal evidence shows that exposure to toluene in utero causes an increased risk of CNS abnormalities and developmental delay in humans (Goodwin, 1988; Hersh et al., 1985; Holmberg, 1979). Animal studies, in which toluene was administered by inhalation, showed that exposure results in fetotoxicity and delayed skeletal development but does not cause internal or external malformations in rats (Courtney et al., 1986; Litton Bionetics, 1978). An oral study noted an increased incidence of embryonic deaths, cleft palate, and maternal toxicity in mice administered 1 mL/kg toluene during gestation (Nawrot and Staples, 1979).

An oral reference dose (RfD) of 2 mg/kg/day for subchronic exposure (EPA, 1993) and 0.2 mg/kg/day for chronic exposure (EPA, 1992) to toluene was calculated based on a no-observed-adverse-effect level (NOAEL) of 223 mg/kg/day and a lowest-observed-adverse-effect level (LOAEL) of 446 mg/kg/day from a 13-week subchronic gavage study in rats (NTP, 1990). Increased liver and kidney weights in males were identified as the critical effects. A subchronic (EPA, 1993) and chronic inhalation reference concentration (RfC) of 0.4 mg/m^3 (EPA, 1992) was calculated based on results of a battery of neurological tests with occupationally exposed female subjects (Foo et al., 1990).

An increased incidence of hemolymphoreticular neoplasms was reported in rats exposed to 500 mg/kg of toluene by gavage for 2 years (Maltoni et al., 1985); however, results from two long-term inhalation studies (NTP, 1990; Gibson and Hardisty, 1983) indicate that toluene is not carcinogenic at concentrations up to 1200 ppm. Based on U.S. Environmental Protection Agency (EPA) guidelines, toluene was assigned to weight-of-evidence group D, not classifiable as to human carcinogenicity (EPA, 1992).

Last Updated 2/13/98

XYLENE

NOTE: Although the toxicity values presented in these toxicity profiles were correct at the time they were produced, these values are subject to change. Users should always refer to the Toxicity Value Database for the current toxicity values.

September 1994
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*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under contract No. DE-AC05-84OR21400

Xylene (dimethylbenzene) is a colorless, flammable liquid that is used as a solvent in the printing, rubber, and leather industries and as a cleaner and paint thinner. It occurs naturally in petroleum and coal tar. Xylene is absorbed following oral, dermal, or inhalation exposure; can be stored in adipose tissue; and is eliminated in the urine after conjugation with glycine.

Human exposure to xylene by either oral or inhalation routes can cause death due to respiratory failure accompanied by pulmonary congestion (Sandmeyer, 1981). Nonlethal levels of xylene vapor may cause eye (Carpenter et al., 1975), nose, and throat (ATSDR, 1993) irritation, and contact with liquid may result in dermatitis (Sittig, 1985). Chronic occupational exposure to xylene has been associated with headaches, chest pain, electrocardiographic abnormalities, dyspnea, cyanosis of hands, fever, leukopenia, malaise, impaired lung function, and confusion (Hipolito, 1980).

Long-term gavage studies with mixed xylenes in laboratory animals resulted in decreased body weight gain in male rats given 500 mg/kg/day and hyperactivity in male and female mice given 1000 mg/kg/day (NTP, 1986). A chronic oral reference dose (RfD) of 2 mg/kg/day for mixed xylenes was calculated from a no-observed-adverse-effect level (NOAEL) of 250 mg/kg/day derived from a chronic gavage study with rats (EPA, 1994a). The critical effects were hyperactivity, decreased body weight, and increased mortality (males). An RfD of 2 mg/kg/day is also reported for the *m*- and *o*-xylene isomers (EPA, 1994b).

Inhalation of 3000 mg/m^3 of the *o*-, *p*-, or *m*-xylene isomer by rats on gestation days 7-14 resulted in decreased fetal weights, skeletal anomalies, and altered fetal enzyme activities (Hood and Ottley, 1988). Rib anomalies and cleft palate occurred in mouse fetuses following maternal oral exposure of 2.06

g/kg/day of mixed xylenes on gestation days 6-15 (Marks et al., 1982). An inhalation reference concentration (RfC) is under review by EPA (1994a).

Oral (NTP, 1986) and topical (Berenblum, 1941; Pound, 1970) carcinogenic studies with xylene in laboratory animals gave negative results. EPA (1994a) has placed xylene in weight-of-evidence group D, not classifiable as to human carcinogenicity. No significant increase in tumor incidence was observed in rats or mice of both sexes following oral administration of technical grade xylene.

Last Updated 8/29/97

APPENDIX I

MassDEP METHOD 3 SHORTFORM RISK CHARACTERIZATION

FOR RTN 3-28545 AND RTN 3-28546

CLEAN PROPERTIES, INC., 111 Boston Post Road, Suite 211, Sudbury, MA 01776
Phone: 978-443-6622 Fax: 781-577-1510 Email: Public@CleanProperties.com

Method 3 Risk Assessment for Resident Exposed to Chemicals in Soil - Shortform 2006 (sf06rs)

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cNC Eq	Table RS-3:	Equations to calculate chronic noncancer risks.
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Exp	Table RS-5:	Definitions and exposure factors.
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Spreadsheets designed by Andrew Friedmann, MassDEP
Questions and Comments may be addressed to:
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Resident - Soil: Table RS-1
Exposure Point Concentration (EPC)
Based on Resident Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 4-06

Vlookup Version v0808

ELCR (all chemicals) = 6E-07

Chronic HI (all chemicals) = 8E-01

Subchronic HI (all chemicals) = 2E-01

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	$ELCR_{ingestion}$	$ELCR_{dermal}$	$ELCR_{vegetable}$	$ELCR_{total}$	Chronic HQ_{ing}	Chronic HQ_{derm}	Chronic $HQ_{vegetable}$	Chronic HQ_{total}	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic $HQ_{vegetable}$	Subchronic HQ_{total}
Benzene	1.3E-01	2.7E-09	2.2E-09		4.9E-09	7.9E-05	5.4E-05		1.3E-04	8.7E-05	4.1E-05		1.3E-04
Toluene	1.3E-01					3.9E-06	4.0E-06		8.0E-06	1.1E-06	7.6E-07		1.8E-06
Ethylbenzene	3.8E+00					9.1E-05	1.6E-04		2.5E-04	2.5E-05	2.9E-05		5.5E-05
Xylenes (mixed isomers)	3.6E+00					4.3E-05	4.4E-05		8.7E-05	1.2E-04	8.4E-05		2.0E-04
Naphthalene	7.3E-01					3.2E-05	7.6E-05		1.1E-04	8.8E-06	1.4E-05		2.3E-05
Aliphatics C5 to C8	3.7E+01					2.2E-03	1.9E-02		2.1E-02	6.1E-04	3.6E-03		4.2E-03
Aliphatics C9 to C12	2.0E+03					4.8E-02	2.1E-01		2.5E-01	1.3E-02	3.9E-02		5.2E-02
Aliphatics C9 to C18	4.0E+02					9.8E-03	4.2E-02		5.1E-02	2.7E-03	7.9E-03		1.1E-02
Aromatics C9 to C10	1.2E+03					9.6E-02	4.1E-01		5.0E-01	2.6E-02	7.7E-02		1.0E-01
Aliphatics C19 to C36	2.8E+01					3.4E-05	2.9E-05		6.3E-05	3.1E-05	1.8E-05		5.0E-05
Aromatics C11 to C22	3.1E+01					9.1E-04	2.1E-03		3.1E-03	2.5E-04	4.1E-04		6.6E-04
Methylnaphthalene, 2-	1.9E-01					4.1E-05	9.7E-05		1.4E-04	1.1E-04	1.8E-04		3.0E-04
Phenanthrene	1.9E-01					5.5E-06	1.3E-05		1.8E-05	1.5E-06	2.4E-06		3.9E-06
Acenaphthylene	1.8E-01					5.1E-06	1.2E-05		1.7E-05	1.4E-06	2.3E-06		3.7E-06
Acenaphthene	1.8E-01					2.6E-06	6.1E-06		8.7E-06	7.1E-07	1.2E-06		1.9E-06
Fluorene	1.8E-01					3.9E-06	9.1E-06		1.3E-05	1.1E-06	1.7E-06		2.8E-06
Anthracene	1.8E-01					5.1E-07	1.2E-06		1.7E-06	1.4E-07	2.3E-07		3.7E-07
Fluoranthene	2.4E-01					5.1E-06	1.2E-05		1.7E-05	1.4E-06	2.3E-06		3.7E-06
Pyrene	2.3E-01					6.7E-06	1.6E-05		2.2E-05	1.8E-06	3.0E-06		4.8E-06
Benzo(a)anthracene	1.8E-01	1.4E-08	1.0E-08		2.4E-08	4.0E-06	2.4E-06		6.4E-06	1.1E-06	4.6E-07		1.6E-06
Chrysene	1.8E-01	1.4E-09	1.0E-09		2.4E-09	4.0E-06	2.4E-06		6.4E-06	1.1E-06	4.6E-07		1.6E-06
Benzo(b)fluoranthene	1.8E-01	1.4E-08	1.0E-08		2.4E-08	4.0E-06	2.4E-06		6.4E-06	1.1E-06	4.6E-07		1.6E-06
Benzo(k)fluoranthene	1.8E-01	1.4E-09	1.0E-09		2.4E-09	4.0E-06	2.4E-06		6.4E-06	1.1E-06	4.6E-07		1.6E-06
Benzo(a)pyrene	1.8E-01	1.4E-07	1.0E-07		2.4E-07	4.0E-06	2.4E-06		6.4E-06	1.1E-06	4.6E-07		1.6E-06
Indeno(1,2,3-cd)pyrene	1.8E-01	1.4E-08	1.0E-08		2.4E-08	4.0E-06	2.4E-06		6.4E-06	1.1E-06	4.6E-07		1.6E-06
Dibenzo(a,h)anthracene	1.8E-01	1.4E-07	1.0E-07		2.4E-07	4.0E-06	2.4E-06		6.4E-06	1.1E-06	4.6E-07		1.6E-06
Benzo(g,h,i)perylene	1.8E-01					5.1E-06	1.2E-05		1.7E-05	1.4E-06	2.3E-06		3.7E-06

Resident - Soil: Table RS-2
Equations to Calculate Cancer Risk for Resident (Age 1-31 years)

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing(1\text{-}31)} * CSF$$

$$LADD_{ing\ (1\text{-}31)} = LADD_{ing\ (1\text{-}8)} + LADD_{ing\ (8\text{-}15)} + LADD_{ing\ (15\text{-}31)}$$

$$LADD_{ing\ (age\ group\ x)} = \frac{[OHM]_{soil} * IR_x * RAF_{c\text{-}ing} * EF_{ing} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm\ (1\text{-}31)} = LADD_{derm\ (1\text{-}8)} + LADD_{derm\ (8\text{-}15)} + LADD_{derm\ (15\text{-}31)}$$

$$LADD_{derm(age\ group\ x)} = \frac{[OHM]_{soil} * SA_x * RAF_{c\text{-}derm} * SAF_x * EF_{derm} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Homegrown Produce

$$ELCR_{produce} = LADD_{produce(1\text{-}31)} * CSF$$

$$LADD_{produce(1\text{-}31)} = LADD_{produce(1\text{-}8)} + LADD_{produce(8\text{-}15)} + LADD_{produce(15\text{-}31)}$$

$$LADD_{produce(age\ x)} = \frac{[OHM_{soil}] * PUF * PIR_x * RAF_{produce} * EF_{produce} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
$IR_{(1\text{-}8)}$	100	mg/day
$IR_{(8\text{-}15)}$	50	mg/day
$IR_{(15\text{-}31)}$	50	mg/day
$PIR_{(1\text{-}8)}$	12,099	mg/day
$PIR_{(8\text{-}15)}$	17,809	mg/day
$PIR_{(15\text{-}31)}$	24,420	mg/day
$RAF_{c\text{-}ing}$	OHM specific	dimensionless
$RAF_{c\text{-}derm}$	OHM specific	dimensionless
$RAF_{c\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.412	event/day
$EF_{produce}$	1.00	event/day
ED	1	day/event
$EP_{(1\text{-}8)}$	7	years
$EP_{(8\text{-}15)}$	7	years
$EP_{(15\text{-}31)}$	16	years
C	0.000001	kg/mg
$BW_{(1\text{-}8)}$	17.0	kg
$BW_{(8\text{-}16)}$	39.9	kg
$BW_{(16\text{-}31)}$	58.7	kg
$AP_{(lifetime)}$	70	years
$SA_{(1\text{-}8)}$	2431	cm^2 / day
$SA_{(8\text{-}15)}$	4427	cm^2 / day
$SA_{(15\text{-}31)}$	5653	cm^2 / day
$SAF_{(1\text{-}8)}$	0.35	mg/cm^2
$SAF_{(8\text{-}15)}$	0.14	mg/cm^2
$SAF_{(15\text{-}31)}$	0.13	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Resident - Soil: Table RS-3
Equations to Calculate Chronic Noncancer Risk for Resident Child (Age 1-8 years)

Vlookup Version v0808

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD}$$

$$ADD_{produce} = \frac{[OHM_{soil}] * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	100	mg/day
PIR	12,099	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$RAF_{nc\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.412	event/day
$EF_{produce}$	1.00	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
EP	7	years
$EP_{cyanide}$	1	day
C	0.000001	kg/mg
BW	17.0	kg
AP	7	year
$AP_{cyanide}$	1	day
SA	2431	cm^2 / day
SAF	0.35	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Resident - Soil: Table RS-4
Equations to Calculate Subchronic Noncancer Risk for Resident Child (Age 1-2 years)

Vlookup Version v0808

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD_{subchronic}}$$

$$ADD_{produce} = \frac{[OHM_{soil}] * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	100	mg/day
PIR	10,900	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$RAF_{nc\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.714	event/day
$EF_{produce}$	1.00	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
$EP_{cyanide}$	1	day
EP	0.577	years
C	0.000001	kg/mg
BW	10.7	kg
AP	0.577	year
$AP_{cyanide}$	1	day
SA	1670	cm^2 / day
SAF	0.35	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Resident - Soil: Table RS-5
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
LADE - Lifetime Average Daily Exposure	chemical specific	$\mu g/m^3$	
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
ADE - Average Daily Exposure	chemical specific	mg/m^3	
EPC - Exposure Point Concentration	chemical specific	mg/kg	
PUF - Plant Uptake Factor	chemical specific	$(mg/mg)(mg/mg)^{-1}$	See Table RS-7; $(mg_{OHM}/mg_{plant})/(mg_{OHM}/mg_{soil})^{-1}$
$IR_{(1-2)}$ - Soil Ingestion Rate for age group 1-2	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
$IR_{(1-8)}$ - Soil Ingestion Rate for age group 1-8	100	mg/day	Ibid
$IR_{(8-15)}$ - Soil Ingestion Rate for age group 8-15	50	mg/day	Ibid
$IR_{(15-31)}$ - Soil Ingestion Rate for age group 15-31	50	mg/day	Ibid
$PIR_{(1-2)}$ = Produce Ingestion Rate for age group 1-2	10,900	mg/day	see Table RS-6
$PIR_{(1-8)}$ = Produce Ingestion Rate for age group 1-8	12,099	mg/day	see Table RS-6
$PIR_{(8-15)}$ = Produce Ingestion Rate for age group 8-15	17,809	mg/day	Ibid
$PIR_{(15-31)}$ = Produce Ingestion Rate for age group 15-31	24,420	mg/day	Ibid
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
$EF_{subchronic}$ - Exposure Frequency for subchronic ingestion or dermal exposure	0.714	event/day	5 days/week
$EF_{chronic}$ - Exposure Frequency for chronic ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
EF_{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
$EF_{produce}$ - Exposure Frequency for produce ingestion, cancer and noncancer	1.00	event/day	
$EF_{cyanide}$ - Exposure Frequency for subchronic and chronic non-cancer cyanide	1.00	event/day	
ED - Exposure Duration	1	day/event	
$EP_{(1-2)}$ - Exposure Period for age group 1-2	0.577	years	30 weeks
$EP_{(1-8)}$ - Exposure Period for age group 1-8	7	years	
$EP_{(8-15)}$ - Exposure Period for age group 8-15	7	years	
$EP_{(15-31)}$ - Exposure Period for age group 15-31	16	years	
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$BW_{(1-2)}$ - Body Weight for age group 1-2	10.7	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, females.
$BW_{(1-8)}$ - Body Weight for age group 1-8	17.0	kg	Ibid
$BW_{(8-15)}$ - Body Weight for age group 8-15	39.9	kg	Ibid
$BW_{(15-31)}$ - Body Weight for age group 15-31	58.7	kg	Ibid
$AP_{subchronic}$ - Averaging Period for subchronic noncancer	0.577	years	30 weeks
$AP_{chronic}$ - Averaging Period for chronic noncancer	7	years	
AP_{cancer} - Averaging Period for lifetime	70	years	
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$SA_{(1-2)}$ - Surface Area for age group 1-2	1670	cm^2 / day	50th percentile of face (1/3 head), forearms, hands, lower legs, and feet for females MADEP. 1995. Guidance for Disposal Site Risk Characterization. Appendix Table B-2.
$SA_{(1-8)}$ - Surface Area for age group 1-8	2431	cm^2 / day	Ibid
$SA_{(8-15)}$ - Surface Area for age group 8-15	4427	cm^2 / day	Ibid
$SA_{(15-31)}$ - Surface Area for age group 15-31	5653	cm^2 / day	Ibid
$SAF_{(1-2)}$. Surface Adherence Factor for age group 1-2	0.35	mg/cm^2	All SAFs developed for ShortForm according to procedure outlined in MA DEP Technical Update:
$SAF_{(1-8)}$. Surface Adherence Factor for age group 1-8	0.35	mg/cm^2	Weighted Skin-Soil Adherence Factors, April 2002
$SAF_{(8-15)}$ - Surface Adherence Factor for age group 8-15	0.14	mg/cm^2	
$SAF_{(15-31)}$ - Surface Adherence Factor for age group 15-31	0.13	mg/cm^2	

Resident - Soil: Table RS-6
Homegrown Produce Ingestion Rate

Data on mean produce ingestion rates (wet weight, ww) in the Northeast was obtained from the 1994-1996 Continuing Survey of Food Intakes by Individuals (USDA). Data for both genders were used for children under 6, while data for males was used for individuals 6 and older. The mean ingestion rates presented in the survey represent the arithmetic average of all individuals surveyed, regardless of whether or not they had consumed the produce item (e.g., an individual that did not consume the produce item was assigned a rate of 0 g/day). To determine the mean ingestion rate for individuals who ate each produce item, the ingestion rate for all individuals (consumers and nonconsumers) was divided by the percentage of individuals who ate the item (Table RS-6A). These mean ingestion rates for the produce consumers were summed to determine the total produce ingestion rate for each age-group and converted to dry weight assuming the produce items were all 90% water.

To convert mean ingestion rates for the age-groups studied in the survey to age-groups used in risk calculations, each age-group ingestion rate from the survey (i.e., 1 - 2 year olds, 3 - 5 year olds, 6 - 11 year olds, 12 - 19 year olds, and 20 - 39 year olds) was weighted according to the number of years spent in the risk calculation age group (i.e., 1 - 8 year olds, 8 - 15 year olds, and 15 - 31 year olds) (Table RS-6B). It was assumed that 25% of produce ingested was home-grown (Table RS-6C).

Table RS-6A

Age-groups studied in survey	White Potatoes: Ingestion Rate for All g/d (ww)	White Potatoes: % of individuals that consumed item.	White Potatoes: Ingestion Rate for Consumers g/d (ww)	Dark-green vegetables: Ingestion Rate for All g/d (ww)	Dark-green vegetables: % of individuals that consumed item.	Dark-green vegetables: Ingestion Rate for Consumers g/d (ww)	Deep-yellow vegetables: Ingestion Rate for All g/d (ww)	Deep-yellow vegetables: % of individuals that consumed item.	Deep-yellow vegetables: Ingestion Rate for Consumers g/d (ww)
1-2	28	40.3	69.5	6	10.1	59.4	5	12.7	39.4
3-5	30	37.1	80.9	5	6.5	76.9	7	12.7	55.1
6-11	47	44.2	106.3	6	9.1	65.9	2	8.5	23.5
12-19	59	40.3	146.4	2	2.3	87.0	11	15.8	69.6
20-39	76	45.1	168.5	25	14.7	170.1	4	5.7	70.2

Age-groups studied in survey	Tomatoes: Ingestion Rate for All g/d (ww)	Tomatoes: % of individuals that consumed item.	Tomatoes: Ingestion Rate for Consumers g/d (ww)	Lettuce: Ingestion Rate for All g/d (ww)	Lettuce: % of individuals that consumed item.	Lettuce: Ingestion Rate for Consumers g/d (ww)	Green Beans: Ingestion Rate for All g/d (ww)	Green Beans: % of individuals that consumed item.	Green Beans: Ingestion Rate for Consumers g/d (ww)
1-2	10	27.9	35.8	1	6	16.7	7	12.1	57.9
3-5	10	37.1	27.0	4	14	28.6	3	5.7	52.6
6-11	20	42	47.6	8	14.9	53.7	1	2	50.0
12-19	29	45.2	64.2	19	28.7	66.2	2	2.4	83.3
20-39	48	50.9	94.3	18	29.6	60.8	4	3.7	108.1

Table RS-6A (continued)

Corn, Green peas, Lima beans: Ingestion	Corn, Green peas, Lima beans: Ingestion	Melons, berries: Ingestion	Melons, berries: Ingestion	Totals: Wet Weight	Totals: Dry Weight

Age-groups studied in survey	Rate for All g/d (ww)	% of individuals that consumed item.	Rate for Consumers g/d (ww)	Rate for All g/d (ww)	% of individuals that consumed item.	Rate for Consumers g/d (ww)	WWI g/day	DWI g/day
1-2	12	15	80.0	7	9	77.8	436.4	43.6
3-5	14	21.7	64.5	14	11.6	120.7	506.3	50.6
6-11	9	13.6	66.2	5	5.9	84.7	498.0	49.8
12-19	14	9.9	141.4	17	5	340.0	998.1	99.8
20-39	12	7.3	164.4	6	4.5	133.3	969.7	97.0

Table RS-6B

Age-groups studied in survey	Years spent in age-group for 1-8 year old	Years spent in age-group for 8-15 year old	Years spent in age-group for 15-31 year old
1-2	2		
3-5	3		
6-11	2	4	
12-19		3	4
20-39			12
	7	7	16

Table RS-6C

	Produce Intake, dry weight			
	Child 1-2 years g/day	Child 1-8 years g/day	Child 8-15 years g/day	Adult 15-31 g/day
All Produce:	43.6	48.4	71.2	97.7
Homegrown:	10.9	12.1	17.8	24.4

Resident - Soil: Table RS-7
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	CSF (mg/kg-day)$^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	$RAF_{c\text{-}prod}$	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic $RAF_{nc\text{-}ing}$	Chronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$	$RAF_{nc\text{-}prod}$	PUF
Benzene	5.5E-02	1.00	0.08		4.0E-03	1.0E-02	1	0.08	1	0.08		
Toluene					8.0E-02	8.0E-01	1	0.12	1	0.12		
Ethylbenzene					1.0E-01	1.0E+00	1	0.2	1	0.2		
Xylenes (mixed isomers)					2.0E-01	2.0E-01	1	0.12	1	0.12		
Naphthalene					2.0E-02	2.0E-01	0.36	0.1	0.36	0.1		
Aliphatics C5 to C8					4.0E-02	4.0E-01	1	1	1	1		
Aliphatics C9 to C12					1.0E-01	1.0E+00	1	0.5	1	0.5		
Aliphatics C9 to C18					1.0E-01	1.0E+00	1	0.5	1	0.5		
Aromatics C9 to C10					3.0E-02	3.0E-01	1	0.5	1	0.5		
Aliphatics C19 to C36					2.0E+00	6.0E+00	1	0.1	1	0.1		
Aromatics C11 to C22					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
Methylnaphthalene, 2-					4.0E-03	4.0E-03	0.36	0.1	0.36	0.1		
Phenanthrene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
Acenaphthylene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
Acenaphthene					6.0E-02	6.0E-01	0.36	0.1	0.36	0.1		
Fluorene					4.0E-02	4.0E-01	0.36	0.1	0.36	0.1		
Anthracene					3.0E-01	3.0E+00	0.36	0.1	0.36	0.1		
Fluoranthene					4.0E-02	4.0E-01	0.36	0.1	0.36	0.1		
Pyrene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
Benzo(a)anthracene	7.3E-01	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Chrysene	7.3E-02	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(b)fluoranthene	7.3E-01	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(k)fluoranthene	7.3E-02	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(a)pyrene	7.3E+00	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Indeno(1,2,3-cd)pyrene	7.3E-01	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Dibenzo(a,h)anthracene	7.3E+00	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(g,h,i)perylene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		

Method 3 Risk Assessment for Chemicals in Soil - Construction Worker Shortform 2008 (sf08cw)

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Spreadsheets designed by Andrew Friedmann, MassDEP

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Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk
Based on Construction Worker 18-25 years of age

ShortForm Version 08-08

Vlookup Version v0808

ELCR (all chemicals) = 1E-08

HI (all chemicals) = 5E-02

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material (OHM)	EPC (mg/kg)	ELCR ingestion	ELCR dermal	ELCR inhalation GI	ELCR Inhalation pulmonary	$ELCR_{total}$	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic HQ_{inh-GI}	Subchronic HQ_{inh}	HQ_{total}
Benzene	1.3E-01	6.3E-11	5.1E-11	1.6E-12	2.7E-13	1.2E-10	1.6E-05	1.3E-05	4.2E-07	5.4E-08	3.0E-05
Toluene	1.3E-01						2.0E-07	2.4E-07	5.2E-09	9.7E-10	4.5E-07
Ethylbenzene	3.8E+00						4.6E-06	9.4E-06	1.2E-07	1.4E-07	1.4E-05
Xylenes (mixed isomers)	3.6E+00						2.2E-05	2.7E-05	5.7E-07	4.4E-07	5.0E-05
Naphthalene	7.3E-01						1.6E-06	4.5E-06	4.2E-08	9.1E-06	1.5E-05
Aliphatics C5 to C8	3.7E+01						1.1E-04	1.1E-03	2.9E-06	6.9E-06	1.3E-03
Aliphatics C9 to C12	2.0E+03						2.5E-03	1.2E-02	6.4E-05	1.2E-04	1.5E-02
Aliphatics C9 to C18	4.0E+02						5.0E-04	2.5E-03	1.3E-05	2.5E-05	3.0E-03
Aromatics C9 to C10	1.2E+03						4.9E-03	2.4E-02	1.3E-04	8.8E-05	3.0E-02
Aliphatics C19 to C36	2.8E+01						5.8E-06	5.9E-06	1.5E-07		1.2E-05
Aromatics C11 to C22	3.1E+01						4.6E-05	1.3E-04	1.2E-06	2.3E-06	1.8E-04
Methylnaphthalene, 2-	1.9E-01						2.1E-05	5.8E-05	5.4E-07	1.4E-08	8.0E-05
Phenanthrene	1.9E-01						2.8E-07	7.8E-07	7.2E-09	1.4E-08	1.1E-06
Acenaphthylene	1.8E-01						2.6E-07	7.3E-07	6.8E-09	1.3E-08	1.0E-06
Acenaphthene	1.8E-01						1.3E-07	3.7E-07	3.4E-09	1.3E-08	5.1E-07
Fluorene	1.8E-01						2.0E-07	5.5E-07	5.1E-09	1.3E-08	7.6E-07
Anthracene	1.8E-01						2.6E-08	7.3E-08	6.8E-10	1.3E-08	1.1E-07
Fluoranthene	2.4E-01						2.6E-07	7.3E-07	6.8E-09	1.8E-08	1.0E-06
Pyrene	2.3E-01						3.4E-07	9.5E-07	8.8E-09	1.7E-08	1.3E-06
Benzo(a)anthracene	1.8E-01	3.2E-10	2.3E-10	8.2E-12	9.8E-12	5.6E-10	2.0E-07	1.5E-07	5.3E-09	1.3E-08	3.7E-07
Chrysene	1.8E-01	3.2E-11	2.3E-11	8.2E-13	9.8E-13	5.6E-11	2.0E-07	1.5E-07	5.3E-09	1.3E-08	3.7E-07
Benzo(b)fluoranthene	1.8E-01	3.2E-10	2.3E-10	8.2E-12	9.8E-12	5.6E-10	2.0E-07	1.5E-07	5.3E-09	1.3E-08	3.7E-07
Benzo(k)fluoranthene	1.8E-01	3.2E-11	2.3E-11	8.2E-13	9.8E-13	5.6E-11	2.0E-07	1.5E-07	5.3E-09	1.3E-08	3.7E-07
Benzo(a)pyrene	1.8E-01	3.2E-09	2.3E-09	8.2E-11	9.8E-11	5.6E-09	2.0E-07	1.5E-07	5.3E-09	1.3E-08	3.7E-07
Indeno(1,2,3-cd)pyrene	1.8E-01	3.2E-10	2.3E-10	8.2E-12	9.8E-12	5.6E-10	2.0E-07	1.5E-07	5.3E-09	1.3E-08	3.7E-07
Dibenzo(a,h)anthracene	1.8E-01	3.2E-09	2.3E-09	8.2E-11	9.8E-11	5.6E-09	2.0E-07	1.5E-07	5.3E-09	1.3E-08	3.7E-07
Benzo(g,h,i)perylene	1.8E-01						2.6E-07	7.3E-07	6.8E-09	1.3E-08	1.0E-06

Construction Worker - Soil: Table CW-2
Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c\text{-}ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c\text{-}derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh\text{-}GI} = LADD_{inh\text{-}GI} * CSF_{oral}$$

$$LADD_{inh\text{-}GI} = \frac{EPC * RCAF_{inh\text{-}gi} * PM_{10} * VR_{work} * RAF_{c\text{-}ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c\text{-}inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
$RAF_{c\text{-}ing}$	OHM-specific	dimensionless
$RAF_{c\text{-}derm}$	OHM-specific	dimensionless
$RAF_{c\text{-}inh}$	OHM-specific	dimensionless
EF	0.714	event/day
$ED_{ing\ \&\ derm}$	1	day/event
ED_{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m^3/L
BW	58.0	kg
$AP_{(lifetime)}$	25,550	days
VR_{work}	60	L/min
AF	0.29	mg/cm^2
SA	3473	cm^2/day
$RCAF_{inh\text{-}gi}$	1.5	dimensionless
$RCAF_{inh}$	0.5	dimensionless
PM_{10}	60	$\mu g/m^3$

Construction Worker - Soil: Table CW-3
Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0808

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc\text{-}ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{dermal} = \frac{EPC * SA * AF * RAF_{nc\text{-}derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh\text{-}GI} = \frac{ADD_{inh\text{-}GI}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{inh\text{-}GI} = \frac{EPC * RCAF_{inh\text{-}gi} * PM_{10} * VR_{work} * RAF_{nc\text{-}ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation\text{-}subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc\text{-}inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
$RAF_{nc\text{-}ing}$	OHM-specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM-specific	dimensionless
$RAF_{nc\text{-}inh}$	OHM-specific	dimensionless
EF	0.714	event/day
$EF_{cyanide}$	1	event/day
$ED_{ing\ \&\ derm}$	1	day/event
ED_{inh}	0.333	day/event
EP	182	days
$EP_{cyanide}$	1.00	day
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m^3/L
BW	58.0	kg
$AP_{noncancer}$	182	days
$AP_{cyanide}$	1	day
VR_{work}	60	L/min
AF	0.29	mg/cm^2
SA	3473	cm^2/day
$RCAF_{inh\text{-}gi}$	1.5	dimensionless
$RCAF_{inh}$	0.5	dimensionless
PM10	60	$\mu g/m^3$

Cyanide can cause a significant health risk from a one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Construction Worker - Soil: Table CW-4
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	µg/L	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF_{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
$EF_{cyanide}$ - Exposure Frequency for Cyanide Exposures	1.00	event/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$ED_{ing,derm}$ - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED_{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
$AP_{(lifetime)}$ - Averaging Period for lifetime	25,550	days	Represents 70 years
$AP_{(noncancer)}$ - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
AF - Adherence Factor	0.29	mg/cm^2	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR_{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm^2/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
$RCAF_{inh\text{-}gi}$ - Relative Concentration Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
$RCAF_{inh}$ - Relative Concentration Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM_{10}	60	$\mu g/m^3$	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Cyanide Exposure Parameters

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	Oral CSF $(mg/kg\text{-}day)^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	$RAF_{c\text{-}inh}$	Inhalation CSF $(mg/kg\text{-}day)^{-1}$	Subchronic Oral RfD mg/kg-day	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}inh}$	Subchronic Inhalation RfD
Benzene	5.5E-02	1	0.08	1	2.7E-02	1.0E-02	1	0.08	1	2.6E-02
Toluene						8.0E-01	1	0.12	1	1.4E+00
Ethylbenzene						1.0E+00	1	0.2	1	2.9E-01
Xylenes (mixed isomers)						2.0E-01	1	0.12	1	8.6E-02
Naphthalene						2.0E-01	0.36	0.1	1	8.6E-04
Aliphatics C5 to C8						4.0E-01	1	1	1	5.7E-02
Aliphatics C9 to C12						1.0E+00	1	0.5	1	1.7E-01
Aliphatics C9 to C18						1.0E+00	1	0.5	1	1.7E-01
Aromatics C9 to C10						3.0E-01	1	0.5	1	1.4E-01
Aliphatics C19 to C36						6.0E+00	1	0.1		
Aromatics C11 to C22						3.0E-01	0.36	0.1	1	1.4E-01
Methylnaphthalene, 2-						4.0E-03	0.36	0.1	1	1.4E-01
Phenanthrene						3.0E-01	0.36	0.1	1	1.4E-01
Acenaphthylene						3.0E-01	0.36	0.1	1	1.4E-01
Acenaphthene						6.0E-01	0.36	0.1	1	1.4E-01
Fluorene						4.0E-01	0.36	0.1	1	1.4E-01
Anthracene						3.0E+00	0.36	0.1	1	1.4E-01
Fluoranthene						4.0E-01	0.36	0.1	1	1.4E-01
Pyrene						3.0E-01	0.36	0.1	1	1.4E-01
Benzo(a)anthracene	7.3E-01	0.28	0.02	1	7.3E-01	3.0E-01	0.28	0.02	1	1.4E-01
Chrysene	7.3E-02	0.28	0.02	1	7.3E-02	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(b)fluoranthene	7.3E-01	0.28	0.02	1	7.3E-01	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(k)fluoranthene	7.3E-02	0.28	0.02	1	7.3E-02	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(a)pyrene	7.3E+00	0.28	0.02	1	7.3E+00	3.0E-01	0.28	0.02	1	1.4E-01
Indeno(1,2,3-cd)pyrene	7.3E-01	0.28	0.02	1	7.3E-01	3.0E-01	0.28	0.02	1	1.4E-01
Dibenzo(a,h)anthracene	7.3E+00	0.28	0.02	1	7.3E+00	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(g,h,i)perylene						3.0E-01	0.36	0.1	1	1.4E-01

Table - RG-1: Risk Assessment - ADD and HI Calculations - Contact With Groundwater by Construction Workers (RTN 3-28545 + 3-28546)

Contaminant of Concerns	Groundwater EPC	Dermal Relative Absorption Factor (RAF)	Skin Permeability Constant (Kp)	Exposure Duration (ED)	Exposure Frequency (EF)	Exposure Period (EP)	Averaging Period (AP)	Body Weight (BW)	Surface Area Exposed(SA)[1]	Conversion Constant (C)	Subchronic Average Daily Dose (ADD)	Oral Subchronic Reference Dose (RD)	Hazard Index (HI)
	µg/L		cm/hr	hr/day	2 days/7 days	year	year	Kg	cm^2		mg/(kg-day)	mg/(kg-day)	
VPH C5-C8 Aliphatics	61.6	1.0	1.66E-01	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	3.63163E-05	4.00E-01	9.08E-05
VPH C9-C12 Aliphatics	1,700.0	1.0	1.02E+00	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	0.006158313	1.00E+00	6.16E-03
VPH C9-C10 Aromatics	1,900.0	1.0	1.32E-01	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	0.000893417	3.00E-01	2.98E-03
Benzene	2.5	1.0	1.48E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	1.31051E-07	1.00E-02	1.31E-05
Toluene	2.5	1.0	3.07E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	2.72223E-07	8.00E-01	3.40E-07
Ethylbenzene	2.5	1.0	4.85E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	4.30265E-07	1.00E+00	4.30E-07
Xylenes	5.0	1.0	5.23E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	9.28542E-07	2.00E-01	4.64E-06
Naphtalene	37.0	1.1	4.58E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	6.626E-06	2.00E-01	3.31E-05
EPH C9-C18 Aliphatics	100.0	1.0	1.47E+00	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	5.23E-04	1.00E+00	5.23E-04
EPH C19-C36 Aliphatics	100.0	1.0	0.00E+00	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	0.00E+00	6.00E+00	0.00E+00
EPH C11-C22 Aromatics	166.0	1.1	5.24E-01	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	3.40E-04	3.00E-01	1.13E-03
Total													1.09E-02

Notes

ADD = EPC × RAF × Kp × ED × EF × EP × SA × C/(BW × AP)

HI = ADD/RD

SA : Surface area of arms, hand feet, MDEP, 1995

ED : 15 minute exposure while setting up pump

EF : Twice per week

EP and AP : 6 month project duration (MDEP Shortform)

C : 0.001 mg/Kg × 0.001 L/cm^3 = 1.0E-06

Table - RG-3: Risk Assessment - LADD and ELCR Calculations - Contact With Groundwater by Construction Workers (RTN 3-28545 + 3-28546)

Contaminant of Concerns	Groundwater EPC	Dermal Relative Absorption Factor (RAF)	Skin Permeability Constant (Kp)	Exposure Duration (ED)	Exposure Frequency (EF)	Exposure Period (EP)	Averaging Period (AP)	Body Weight (BW)	Surface Area Exposed (SA)[1]	Conversion Constant (C)	Lifetime Average Daily Dose (LADD)	Oral Cancer Slope Factor (CSF)	Excess Lifetime Cancer Risk (ELCR)
	µg/l.		cm/hr	hr/day	2 days/7 days	year	year	Kg	cm^2		mg/(kg-day)	mg/(kg-day)	
VPH C5-C8 Aliphatics	61.6	1.0	1.66E-01	0.25	0.286	0.5	70	70	3,477	1.00E-06	2.59402E-07	NC	NC
VPH C9-C12 Aliphatics	1,700.0	1.0	1.02E+00	0.25	0.286	0.5	70	70	3,477	1.00E-06	4.3988E-05	NC	NC
VPH C9-C10 Aromatics	1,900.0	1.0	1.32E-01	0.25	0.286	0.5	70	70	3,477	1.00E-06	6.38155E-06	NC	NC
Benzene	2.5	1.0	1.48E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	9.36076E-10	5.50E-02	1.70E-08
Toluene	2.5	1.0	3.07E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	1.94445E-09	NC	NC
Ethylbenzene	2.5	1.0	4.85E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	3.07332E-09	NC	NC
Xylenes	5.0	1.0	5.23E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	6.63244E-09	NC	NC
Naphtalene	37.0	1.1	4.58E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	4.73286E-08	NC	NC
EPH C9-C18 Aliphatics	100.0	1.0	1.47E+00	0.25	0.286	0.5	70	70	3,477	1.00E-06	3.73923E-06	NC	NC
EPH C19-C36 Aliphatics	100.0	1.0	0.00E+00	0.25	0.286	0.5	70	70	3,477	1.00E-06	0	NC	NC
EPH C11-C22 Aromatics	166.0	1.1	5.24E-01	0.25	0.286	0.5	70	70	3,477	1.00E-06	2.42773E-06	NC	NC
Total													1.70E-08

Notes

LADD = EPC × RAF × Kp × ED × EF × EP × 5A × C/(BW × AP)

ELCR = LADD/CSF

NC : Not considered cancer causing

SA : 5urface area of arms, hand feet, MDEP, 1995

ED : 15 minute exposure while setting up pump

EF : Twice per week

EP : 6 month project duration (MDEP 5hortform)

AP : Lifetime of 70 years

C : 0.001 mg/Kg × 0.001 L/cm^3 = 1.0E-06

Method 3 Risk Assessment for a Trespasser Exposed to Chemicals in Soil - Shortform 2006 (sf06ts)

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EPCs	Table TS-1: Select chemicals and enter Exposure Point Concentrations (EPCs). Associated risks are shown to the right.
C Eq	Table TS-2: Equations to calculate cancer risks.
cNC Eq	Table TS-3: Equations to calculate chronic noncancer risks.
scNC Eq	Table TS-4: Equations to calculate subchronic noncancer risks.
Exp	Table TS-5: Definitions and exposure factors.
Chem	Table TS-6: Chemical-specific data.

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Trespasser - Soil: Table TS-1
Exposure Point Concentration (EPC)
Based on Trespasser Ages 11-18 (Cancer and Non-Cancer)

ShortForm Version 6-06

Vlookup Version v0808

ELCR (all chemicals) = 2E-08

Chronic HI (all chemicals) = 5E-02

Subchronic HI (all chemicals) = 1E-02

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	$ELCR_{ingestion}$	$ELCR_{dermal}$	$ELCR_{total}$	Chronic HQ_{ing}	Chronic HQ_{derm}	Chronic HQ_{total}	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic HQ_{total}
Benzene	1.3E-01	1.2E-10	7.7E-11	1.9E-10	5.3E-06	3.5E-06	8.8E-06	4.6E-06	2.6E-06	7.2E-06
Toluene	1.3E-01				2.6E-07	2.6E-07	5.2E-07	5.8E-08	4.8E-08	1.1E-07
Ethylbenzene	3.8E+00				6.1E-06	1.0E-05	1.6E-05	1.3E-06	1.9E-06	3.2E-06
Xylenes (mixed isomers)	3.6E+00				2.9E-06	2.9E-06	5.8E-06	6.3E-06	5.3E-06	1.2E-05
Naphthalene	7.3E-01				2.1E-06	4.9E-06	7.0E-06	4.7E-07	9.0E-07	1.4E-06
Aliphatics C5 to C8	3.7E+01				1.5E-04	1.2E-03	1.4E-03	3.3E-05	2.3E-04	2.6E-04
Aliphatics C9 to C12	2.0E+03				3.2E-03	1.3E-02	1.7E-02	7.1E-04	2.5E-03	3.2E-03
Aliphatics C9 to C18	4.0E+02				6.5E-04	2.7E-03	3.3E-03	1.4E-04	5.0E-04	6.4E-04
Aromatics C9 to C10	1.2E+03				6.4E-03	2.6E-02	3.3E-02	1.4E-03	4.9E-03	6.3E-03
Aliphatics C19 to C36	2.8E+01				2.3E-06	1.9E-06	4.2E-06	1.7E-06	1.2E-06	2.8E-06
Aromatics C11 to C22	3.1E+01				6.1E-05	1.4E-04	2.0E-04	1.3E-05	2.6E-05	3.9E-05
Methylnaphthalene, 2-	1.9E-01				2.7E-06	6.3E-06	9.0E-06	6.0E-06	1.2E-05	1.8E-05
Phenanthrene	1.9E-01				3.7E-07	8.4E-07	1.2E-06	8.0E-08	1.5E-07	2.3E-07
Acenaphthylene	1.8E-01				3.4E-07	7.9E-07	1.1E-06	7.5E-08	1.5E-07	2.2E-07
Acenaphthene	1.8E-01				1.7E-07	3.9E-07	5.7E-07	3.8E-08	7.3E-08	1.1E-07
Fluorene	1.8E-01				2.6E-07	5.9E-07	8.5E-07	5.6E-08	1.1E-07	1.7E-07
Anthracene	1.8E-01				3.4E-08	7.9E-08	1.1E-07	7.5E-09	1.5E-08	2.2E-08
Fluoranthene	2.4E-01				3.4E-07	7.8E-07	1.1E-06	7.5E-08	1.4E-07	2.2E-07
Pyrene	2.3E-01				4.5E-07	1.0E-06	1.5E-06	9.7E-08	1.9E-07	2.9E-07
Benzo(a)anthracene	1.8E-01	5.9E-10	3.4E-10	9.3E-10	2.7E-07	1.6E-07	4.3E-07	5.9E-08	2.9E-08	8.8E-08
Chrysene	1.8E-01	5.9E-11	3.4E-11	9.3E-11	2.7E-07	1.6E-07	4.3E-07	5.9E-08	2.9E-08	8.8E-08
Benzo(b)fluoranthene	1.8E-01	5.9E-10	3.4E-10	9.3E-10	2.7E-07	1.6E-07	4.3E-07	5.9E-08	2.9E-08	8.8E-08
Benzo(k)fluoranthene	1.8E-01	5.9E-11	3.4E-11	9.3E-11	2.7E-07	1.6E-07	4.3E-07	5.9E-08	2.9E-08	8.8E-08
Benzo(a)pyrene	1.8E-01	5.9E-09	3.4E-09	9.3E-09	2.7E-07	1.6E-07	4.3E-07	5.9E-08	2.9E-08	8.8E-08
Indeno(1,2,3-cd)pyrene	1.8E-01	5.9E-10	3.4E-10	9.3E-10	2.7E-07	1.6E-07	4.3E-07	5.9E-08	2.9E-08	8.8E-08
Dibenzo(a,h)anthracene	1.8E-01	5.9E-09	3.4E-09	9.3E-09	2.7E-07	1.6E-07	4.3E-07	5.9E-08	2.9E-08	8.8E-08
Benzo(g,h,i)perylene	1.8E-01				3.4E-07	7.9E-07	1.1E-06	7.5E-08	1.5E-07	2.2E-07

Trespasser - Soil: Table TS-2
Equations to Calculate Cancer Risk for a Trespasser (Age 11-18 years)

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF$$

$$LADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{c\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{c\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{c\text{-}ing}$	OHM specific	dimensionless
$RAF_{c\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.164	event/day
ED	1	day/event
EP	7	years
C	0.000001	kg/mg
BW	50.7	kg
$AP_{(lifetime)}$	70	years
SA	2940	cm^2 / day
SAF	0.14	mg/cm^2

Trespasser - Soil: Table TS-3
Equations to Calculate Chronic Noncancer Risk for a Trespasser (Age 11-18 years)

Vlookup Version v0808

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.164	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
EP	7	years
$EP_{cyanide}$	1	day
C	0.000001	kg/mg
BW	50.7	kg
AP	7	year
$AP_{cyanide}$	1	day
SA	2940	cm^2 / day
SAF	0.14	mg/cm^2

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Trespasser - Soil: Table TS-4
Equations to Calculate Subchronic Noncancer Risk for a Trespasser (Age 11-12 years)

Vlookup Version v0808

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.286	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
$EP_{cyanide}$	1	day
EP	0.577	years
C	0.000001	kg/mg
BW	40.3	kg
AP	0.577	year
$AP_{cyanide}$	1	day
SA	2477	cm^2 / day
SAF	0.14	mg/cm^2

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Trespasser - Soil: Table TS-5
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
EPC - Exposure Point Concentration	chemical specific	mg/kg	
IR - Soil Ingestion Rate	50	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
$EF_{subchronic}$ - Exposure Frequency for subchronic ingestion or dermal exposure	0.286	event/day	2 days/week
$EF_{chronic}$ - Exposure Frequency for chronic ingestion or dermal exposure	0.164	event/day	2 days/week, 30 weeks/year
EF_{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.164	event/day	2 days/week, 30 weeks/year
$EF_{cyanide}$ - Exposure Frequency for cyanide exposure	1.00	event/day	
ED - Exposure Duration	1	day/event	
$EP_{(11\text{-}12)}$ - Exposure Period for age group 11-12	0.577	years	30 weeks
$EP_{(11\text{-}18)}$ - Exposure Period for age group 11-18	7	years	
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$BW_{(11\text{-}12)}$ - Body Weight for age group 11-12	40.3	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7
$BW_{(11\text{-}18)}$ - Body Weight for age group 11-18	50.7	kg	Ibid
$AP_{subchronic}$ - Averaging Period for subchronic noncancer	0.577	years	30 weeks
$AP_{chronic}$ - Averaging Period for chronic noncancer	7	years	
AP_{cancer} - Averaging Period for lifetime	70	years	
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$SA_{(11\text{-}12)}$ - Surface Area for age group 11-12	2477	cm^2 / day	50th percentile of forearms, hands, and feet for females. MADEP 1995 Guidance for Disposal Site Risk Characterization, Table B-2.
$SA_{(11\text{-}18)}$ - Surface Area for age group 11-18	2940	cm^2 / day	Ibid
SAF - Surface Adherence Factor, Trespasser	0.14	mg/cm^2	SAF developed for ShortForm according to procedure outlined in MA DEP Technical Update: Weighted Skin-Soil Adherence Factors, April 2002.

Trespasser - Soil: Table TS-6
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	CSF $(mg/kg\text{-}day)^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic $RAF_{nc\text{-}ing}$	Chronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$
Benzene	5.5E-02	1.00	0.08	4.0E-03	1.0E-02	1	0.08	1	0.08
Toluene				8.0E-02	8.0E-01	1	0.12	1	0.12
Ethylbenzene				1.0E-01	1.0E+00	1	0.2	1	0.2
Xylenes (mixed isomers)				2.0E-01	2.0E-01	1	0.12	1	0.12
Naphthalene				2.0E-02	2.0E-01	0.36	0.1	0.36	0.1
Aliphatics C5 to C8				4.0E-02	4.0E-01	1	1	1	1
Aliphatics C9 to C12				1.0E-01	1.0E+00	1	0.5	1	0.5
Aliphatics C9 to C18				1.0E-01	1.0E+00	1	0.5	1	0.5
Aromatics C9 to C10				3.0E-02	3.0E-01	1	0.5	1	0.5
Aliphatics C19 to C36				2.0E+00	6.0E+00	1	0.1	1	0.1
Aromatics C11 to C22				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Methylnaphthalene, 2-				4.0E-03	4.0E-03	0.36	0.1	0.36	0.1
Phenanthrene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Acenaphthylene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Acenaphthene				6.0E-02	6.0E-01	0.36	0.1	0.36	0.1
Fluorene				4.0E-02	4.0E-01	0.36	0.1	0.36	0.1
Anthracene				3.0E-01	3.0E+00	0.36	0.1	0.36	0.1
Fluoranthene				4.0E-02	4.0E-01	0.36	0.1	0.36	0.1
Pyrene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Benzo(a)anthracene	7.3E-01	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Chrysene	7.3E-02	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(b)fluoranthene	7.3E-01	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(k)fluoranthene	7.3E-02	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(a)pyrene	7.3E+00	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Indeno(1,2,3-cd)pyrene	7.3E-01	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Dibenzo(a,h)anthracene	7.3E+00	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(g,h,i)perylene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1

Vlookup Version v0808				SUBCHRONIC		Chronic		Subchronic						SUBCHRONIC			
OIL OR HAZARDOUS MATERIAL	CAS	CHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Inhalation Reference Concentration (or substituta) mg/m3	REF	Inhalation Raference Concentration (or substitute) mg/m3	REF	Oral Cancer Slope Factor $(mg/kg/day)^{-1}$	CLASS	REF	Inhalation Unit Risk $(\mu g/m3)^{-1}$	REF	INHALATION REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Inhalation Cancer Slope Factor $(mg/kg/day)^{-1}$	REF
Acenaphthene	83-32-9	6 0E-02	1	6 0E-01	2	5 0E-02	44	5 0E-01	44						1 4E-01	45		46
Acenaphthylene	208-96-8	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44		D	1			1 4E-01	45		46
Acetone	67-64-1	9 0E-01	1	2 7E+00	1i	6 0E-01	3	6 0E-01	40		D	1			2 3E-01	45		46
Aldrin	309-00-2	3 0E-05	1	3 0E-05	2	1 1E-04		1 1E-04	40	1 7E+01	B2	1	4 90E-03	1	3 0E-05	45	1 7E+01	46
Anthracene	120-12-7	3 0E-01	1	3 0E+00	2	5 0E-02	44	5 0E-01	44		D	1			1 4E-01	45		46
Antimony	7440-36-0	4 0E-04	1	4 0E-04	2	1 0E-02	3	1 0E-02	40						2 9E-03	45		46
Arsenic	7440-38-2	3 0E-04	1	3 0E-04	2	2 5E-06	3	2 5E-06	40	1 5E+00	A	1	4 30E-03	1	7 1E-07	45	1 5E+01	46
Barium	7440-39-3	2 0E-01	1	7 00E-02	2	5 0E-04	2e	5 0E-03	2b						1 4E-03	45		46
Benzene	71-43-2	4 0E-03	1	1 0E-02	1i	3 0E-02	1	9 0E-02	1k	5 5E-02	A	1	7 80E-06	1	2 6E-02	45	2 7E-02	46
Benz(a)anthracene	56-55-3	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-01	B2	1e	2 09E-04	35	1 4E-01	45	7 3E-01	46
Benzo(a)pyrene	50-32-8	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E+00	B2	1	2 09E-03	35	1 4E-01	45	7 3E+00	46
Benzo(b)fluoranthene	205-99-2	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-01	B2	1e	2 09E-04	35	1 4E-01	45	7 3E-01	46
Benzo(g,h,i)perylene	191-24-2	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44						1 4E-01	45		46
Benzo(k)fluoranthene	207-08-9	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-02	B2	1e	2 09E-05	35	1 4E-01	45	7 3E-02	46
Beryllium	7440-41-7	2 0E-03	1	5 0E-03	2	2 0E-05	1	2 0E-05	1j		B1	1f	2 40E-03	1	5 7E-06	45	6 4E+00	46
Biphenyl, 1,1-	92-52-4	5 0E-02	1	5 0E-02	2	2 0E-03	3	2 0E-03	40		D	1			5 7E-04	45		46
Bis(2-chloroethyl)ether	111-44-4									1 1E+00	B2	1	3 30E-04	1		45	1 2E+00	46
Bis(2-chloroisopropyl)ether	39638-32-9	4 0E-02	1	4 0E-02	1d	1 4E-01	39	1 4E-01	40	7 0E-02	C	2d	1 00E-05	2	4 0E-02	45	3 5E-02	46
Bis(2-ethylhexyl)phthalate	117-81-7	2 0E-02	1	2 0E-02	2d	7 0E-03	3	7 0E-03	40	1 4E-02	B2	1	1 30E-06	3	2 0E-03	45	4 8E-03	46
Bromodichloromethane	75-27-4	2 0E-02	1	2 0E-02	2	7 0E-02	39	7 0E-02	40	6 2E-02	B2	1	1 77E-05	35	2 0E-02	45	6 2E-02	46
Bromoform	75-25-2	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k	7 9E-03	B2	1	1 10E-06	1	2 0E-01	45	3 9E-03	46
Bromomethane	74-83-9	1 4E-03	1	1 4E-02	2d	5 0E-03	1	5 0E-02	1k		D	1			1 4E-02	45		46
Cadmium	7440-43-9	5 0E-04	1c	5 0E-04	1d	2 0E-05	3	2 0E-05	40		B1	1	1 80E-03	1	5 7E-06	45	6 3E+00	46
Carbon tetrachloride	56-23-5	7 0E-04	1	7 0E-03	2d	4 3E-01	3	4 3E-01	40	1 3E-01	B2	1	1 50E-05	1	1 2E-01	45	5 3E-02	46
Chlordane	12789-03-8	5 0E-04	1	5 0E-04	1d	7 0E-04	1	7 0E-03	1k	3 5E-01	B2	1	1 00E-04	1	2 0E-03	45	3 5E-01	46
Chloroaniline, p-	106-47-8	4 0E-03	1	4 0E-03	2	1 4E-02	39	1 4E-02	40						4 0E-03	45		46
Chlorobenzene	108-90-7	2 0E-02	1	2 0E-01	2d	2 0E-02	2e	2 0E-02	40		D	1			5 7E-03	45		46
Chloroform	67-66-3	1 0E-02	1	1 0E-02	2	6 6E-01	3	6 8E-01	40		B2	1	2 30E-05	1	1 9E-01	45	6 1E-02	46
Chlorophenol, 2-	95-57-8	5 0E-03	1	5 0E-02	2	1 6E-02	39	1 6E-01	1k						5 1E-02	45		46
Chromium (total)	7440-47-3	3 0E-03		2 0E-02		1 0E-04		3 0E-04					1 20E-02		8 6E-05	45	4 2E+01	46
Chromium(III)	16065-83-1	1 5E+00	1	1 5E+00	1d	1 0E-04	1h	3 0E-04	1k						8 6E-05	45		46
Chromium(VI)	18540-29-9	3 0E-03	1	2 0E-02	2	1 0E-04	1	3 0E-04	1k				1 20E-02	1	8 6E-05	45	4 2E+01	46
Chrysene	218-01-9	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-02	B2	1e	2 09E-05	35	1 4E-01	45	7 3E-02	46
Cyanide	57-12-5	1 0E-02	4a	1 0E-02	4a	7 0E-03	4	7 0E-03	40		D	1			2 0E-03	45		46
Dibenz(a,h)anthracene	53-70-3	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E+00	B2	1e	2 09E-03	35	1 4E-01	45	7 3E+00	46
Dibromochloromethane	124-48-1	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k	6 4E-02	C	1	2 40E-05	35	2 0E-01	45	6 4E-02	46
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	9 0E-02	1	9 0E-01	2d	2 0E-01	2e	2 0E-01	40		D	1			5 7E-02	45		46
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	9 0E-02	1b	9 0E-01	2a	2 0E-01	2f	2 0E-01	40		D	1			5 7E-02	45		46
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	9 0E-02	1b	9 0E-01	2a	6 0E-01	1	2 4E+00	1k	2 4E-02	C	2	6 86E-06	35	6 9E-01	45	2 4E-02	46
Dichlorobenzidine, 3,3'-	91-94-1									4 5E-01	B2	1	1 29E-04	35		45	4 5E-01	46
DDD	72-54 8	5 0E-04	1g	5 0E-04	2g	1 6E-03	39	1 6E-03	40	2 4E-01	B2	1	6 86E-05	35	5 0E-04	45	2 4E-01	46
DDE	72-55-9	5 0E-04	1g	5 0E-04	2g	1 6E-03	39	1 6E-03	40	3 4E-01	B2	1	9 71E-05	35	5 0E-04	45	3 4E-01	46
DDT	50-29-3	5 0E-04	1	5 0E-04	2	1 6E-03	39	1 6E-03	40	3 4E-01	B2	1	9 70E-05	1	5 0E-04	45	3 4E-01	46
Dichloroethane, 1,1-	75-34-3	1 0E-01	2	1 0E+00	2	5 0E-01	2e	5 0E+00	2b		C	1		35	1 4E+00	45		46
Dichloroethane, 1,2-	107-06-2	2 0E-02	4	2 0E-01	4	5 5E-02	3	5 5E-02	40	9 1E-02	B2	1	2 60E-05	1	1 6E-02	45	9 1E-02	46
Dichloroethylene, 1,1-	75-35-4	5 0E-02	1	5 0E-02	1d	2 0E-01	1	2 0E-01	1j		C	1		1	5 7E-02	45		46
Dichloroethylene, cis-1,2-	156-59-2	1 0E-02	2	1 0E-01	2	3 5E-02	39	3 5E-02	40		D	1			1 0E-02	45		46
Dichloroethylene, trans-1,2-	156-60-5	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k						2 0E-01	45		46
Dichloromethane	75-09-2	6 0E-02	1	6 0E-02	2	3 0E+00	2	3 0E+00	40	7 5E-03	B2	1	4 70E-07	1	6 6E-01	45	1 6E-03	46
Dichlorophenol, 2,4-	120-83-2	3 0E-03	1	3 0E-03	2	1 1E-02	39	1 1E-02	40						3 0E-03	45		46
Dichloropropane, 1,2-	78-87-5					4 0E-03	1	1 2E-02	1k	6 8E-02	B2	2	1 90E-05	3	3 4E-03	45	6 7E-02	46
Dichloropropene, 1,3-	542-75-6	3 0E-02	1	3 0E-02	1d	2 0E-02	1	2 0E-02	1j	1 0E-01	B2	1	4 00E-06	1	5 7E-03	45	1 4E-02	46
Dieldrin	60-57-1	5 0E-05	1	5 0E-05	2	1 6E-04	39	1 6E-04	40	1 6E+01	B2	1	4 60E-03	1	5 0E-05	45	1 6E+01	46
Diethyl phthalate	84-66-2	6 0E-01	1	6 0E+00	2	2 8E+00	39	2 8E+01	1k		D	1			6 0E+00	45		46
Dimethyl phthalate	131-11-3	1 0E+01	2d	1 0E+01	2d	3 5E+01	39	3 5E+01	40		D	1			1 0E+01	45		46
Dimethylphenol, 2,4-	105-67-9	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k						2 0E-01	45		46
Dinitrophenol, 2,4-	51-28-5	2 0E-03	1	2 0E-03	2	7 0E-03	39	7 0E-02	1k						2 0E-02	45		46
Dinitrotoluene, 2,4-	121-14-2	2 0E-03	1	2 0E-03	2	7 0E-03	39	7 0E-03	40	6 8E-01	B2	1a	1 94E-04	35	2 0E-03	45	6 8E-01	46
Dioxane, 1,4-	123-91-1	1 0E-02	5	1 0E-01	5	1 2E-01	2	1 2E-01	40	1 1E-02	B2	1	4 10E-06	3	3 4E-02	45	1 4E-02	46
Endosulfan	115-29-7	6 0E-03	1	6 0E-03	2	2 1E-02	39	2 1E-02	40						6 0E-03	45		46
Endrin	72-20-8	3 0E-04	1	3 0E-04	2	1 1E-03	39	1 1E-03	40		D	1			3 0E-04	45		46
Ethylbenzene	100-41-4	1 0E-01	1	1 0E+00	2d	1 0E+00	1	1 0E+00	1j		D	1			2 9E-01	45		46
Ethylene dibromide	106-93-4	9 0E-03	1	9 0E-03	1d	9 0E-03	1	9 0E-03	40	2 0E+00	B2	1	3 00E-04	1	2 6E-03	45	1 1E+00	46
Fluoranthene	206-44-0	4 0E-02	1	4 0E-01	2	5 0E-02	44	5 0E-01	44		D	1			1 4E-01	45		46
Fluorene	86-73-7	4 0E-02	1	4 0E-01	2	5 0E-02	44	5 0E-01	44						1 4E-01	45		46

Vlookup Version v0808				SUBCHRONIC		Chronic		Subchronic						SUBCHRONIC			
		CHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE)		ORAL REFERENCE DOSE (OR SUBSTITUTE)		Inhalation Reference Concentration (or substitute)		Inhalation Reference Concentration (or substitute)		Oral Cancer Slope Factor			Inhalation Unit Risk		INHALATION REFERENCE DOSE (OR SUBSTITUTE)		Inhalation Cancer Slope Factor	
OIL OR HAZARDOUS MATERIAL	CAS	mg/kg/day	REF	mg/kg/day	REF	mg/m3	REF	mg/m3	REF	$(mg/kg/day)^{-1}$	CLASS	REF	$(\mu g/m3)^{-1}$	REF	mg/kg/day	REF	$(mg/kg/day)^{-1}$	REF
Heptachlor	76-44-8	5.0E-04	1	5.0E-04	2	1.0E-03	3	1.0E-03	40	4.5E+00	B2	1	1.30E-03	1	2.9E-04	45	4.6E+00	46
Heptachlor epoxide	1024-57-3	1.3E-05	1	1.3E-05	2	4.6E-05	39	4.6E-05	40	9.1E+00	B2	1	2.60E-03	1	1.3E-05	45	9.1E+00	46
Hexachlorobenzene	118-74-1	8.0E-04	1	8.0E-04	2d	2.8E-03	39	2.8E-03	40	1.6E+00	B2	1	4.60E-04	1	8.0E-04	45	1.6E+00	46
Hexachlorobutadiene	87-68-3	2.0E-04	2	2.0E-03	2d	7.0E-04	39	7.0E-04	40	7.8E-02	C	1	2.20E-05	1	2.0E-04	45	7.7E-02	46
gamma-HCH	58-89-9	3.0E-04	1	3.0E-03	2	1.1E-03	39	1.1E-02	1k	1.3E+00	B2-C	2	3.71E-04	35	3.1E-03	45	1.3E+00	46
Hexachloroethane	67-72-1	1.0E-03	1	1.0E-02	2	3.0E-03	3	3.0E-03	40	1.4E-02	C	1	4.00E-06	1	8.6E-04	45	1.4E-02	46
Hmx	2691-41-0	5.0E-02	1	5.0E-02	1d	1.8E-01	39	1.8E-01	40		D	1			5.0E-02	45		46
Indeno(1,2,3-cd)pyrene	193-39-5	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E-01	B2	1a	2.09E-04	35	1.4E-01	45	7.3E-01	46
Lead	7439-92-1	7.5E-04	4	7.5E-04	4	1.0E-03	3	1.0E-03	40		B2	1			2.9E-04	45		46
Mercury	7439-97-6	3.0E-04	2d	3.0E-04	2d	3.0E-04	1	3.0E-04	1j		D	1			8.6E-05	45		46
Methoxychlor	72-43-5	5.0E-03	1	5.0E-03	2	1.8E-02	39	1.8E-02	40		D	1			5.0E-03	45		46
Methyl ethyl ketone	78-93-3	6.0E-01	1	8.0E-01	1d	5.0E+00	1	5.0E+00	1j		D	1			1.4E+00	45		46
Methyl isobutyl ketone	108-10-1	8.0E-02	2	8.0E-01	2	3.0E+00	2.l.	3.0E+00	40						8.6E-01	45		46
Methyl mercury	22967-92-6	1.0E-04	1	1.0E-04	2	2.0E-05	3	2.0E-05	40		C	1			5.7E-06	45		46
Methyl tert butyl ether	1634-04-4	1.0E-01	5	1.0E+00	5	3.0E+00	1	3.0E+00	40		C				8.6E-01	45		46
Methylnaphthalene, 2-	91-57-6	4.0E-03	1	4.0E-03	1j	5.0E-02	44	5.0E-01	44						1.4E-01	45		46
Naphthalene	91-20-3	2.0E-02	1	2.0E-01	1i	3.0E-03	1	3.0E-03	40						8.6E-04	45		46
Nickel	7440-02-0	2.0E-02	1	2.0E-02	2	1.0E-03	3	1.0E-03	40		A	1	4.80E-04	1	2.9E-04	45	1.7E+00	46
N-nitrosodimethylamine (NDMA)	62-75-9									5.1E+01	B2	1	1.40E-02	1		45	4.9E+01	46
Pentachlorophenol	87-86-5	3.0E-02	1	3.0E-02	2	7.0E-05	3	7.0E-05	40	1.2E-01	B2	1	3.43E-05	35	2.0E-05	45	1.2E-01	46
Perchlorate	NA	3.0E-05	41	9.0E-05	41	1.1E-04	39	1.1E-04	40						3.0E-05	45		46
Petroleum hydrocarbons	NA															45		48
Aliphatics C5 to C8	NA	4.0E-02	31a	4.0E-01	31	2.0E-01	31	2.0E-01	40						5.7E-02	45		46
Aliphatics C9 to C12	NA	1.0E-01	31a	1.0E+00	31	2.0E-01	31	6.0E-01	40						1.7E-01	45		46
Aliphatics C9 to C18	NA	1.0E-01	31a	1.0E+00	31	2.0E-01	31	6.0E-01	40						1.7E-01	45		46
Aliphatics C19 to C36	NA	2.0E+00	31a	6.0E+00	31		31									45		46
Aromatics C9 to C10	NA	3.0E-02	31a	3.0E-01	31	5.0E-02	31	5.0E-01	40						1.4E-01	45		46
Aromatics C11 to C22	NA	3.0E-02	31a	3.0E-01	31	5.0E-02	31	5.0E-01	40						1.4E-01	45		46
Phenanthrene	85-01-8	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Phenol	108-95-2	3.0E-01	1	3.0E-01	1d	2.6E-01	3	2.6E-01	40		D	1			7.4E-02	45		46
Polychlorinated biphenyls (PCBs)	1336-36-3	2.0E-05	1	5.0E-05	2	2.0E-05	3	2.0E-05	40	2.0E+00	82	1	1.00E-04	1	5.7E-06	45	3.5E-01	46
Pyrene	129-00-0	3.0E-02	1	3.0E-01	2	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Rdx	121-82-4	3.0E-03	1	3.0E-03	1i	1.1E-02	39	1.1E-02	40	1.1E-01	C	1	3.14E-05	35	3.0E-03	45	1.1E-01	46
Selenium	7782-49-2	5.0E-03	1	5.0E-03	2	3.0E-03	3	3.0E-03	40		D	1			8.6E-04	45		46
Silver	7440-22-4	5.0E-03	1	5.0E-03	2	1.4E-04	5	1.4E-04	40		D	1			4.0E-05	45		46
Styrene	100-42-5	2.0E-01	1	2.0E+00	2d	1.0E+00	1	3.0E+00	1k	3.0E-02	82	2d	5.70E-07	2d	8.6E-01	45	2.0E-03	48
TCDD, 2,3,7,8- (equivalents)	1746-01-6									1.5E+05	82	2	3.30E+01	2		45	1.2E+05	46
Tetrachloroethane, 1,1,1,2-	630-20-6	3.0E-02	1	3.0E-02	2	1.1E-01	39	1.1E-01	40	2.6E-02	C	1	7.40E-08	1	3.0E-02	45	2.6E-02	46
Tetrachloroethane, 1,1,2,2-	79-34-5					9.3E-02	3	9.3E-02	40	2.0E-01	C	1	5.80E-05	1	2.7E-02	45	2.0E-01	46
Tetrachloroethylene	127-18-4	1.0E-02	1	1.0E-01	2	4.6E+00	3	4.6E+00	40	5.1E-02	C-B2	2c	1.00E-05	5	1.3E+00	45	3.5E-02	46
Thallium	7440-28-0	8.0E-05	1	8.0E-04	1i	1.4E-05	5	1.4E-05	40						4.0E-06	45		46
Toluene	108-88-3	8.0E-02	1	8.0E-01	1i	5.0E+00	1	5.0E+00	40		D	1			1.4E+00	45		46
Trichlorobenzene, 1,2,4-	120-82-1	1.0E-02	1	1.0E-02	2	2.0E-01	2	2.0E+00	2b		D	1			5.7E-01	45		46
Trichloroethane, 1,1,1-	71-55-6	9.0E-02	2d	9.0E-01	2d	5.2E+00	3	5.2E+00	40		D	1			1.5E+00	45		46
Trichloroethane, 1,1,2-	79-00-5	4.0E-03	1	4.0E-02	2	7.4E-02	3	7.4E-02	40	5.7E-02	C	1	1.60E-05	1	2.1E-02	45	5.6E-02	46
Trichloroethylene	79-01-6	2.0E-03	4	2.0E-02	4	1.8E-01	3	1.8E-01	40	1.1E-02	C-B2	2c	1.70E-06	2d	5.1E-02	45	8.0E-03	46
Trichlorophenol, 2,4,5-	95-95-4	1.0E-01	1	1.0E+00	2	3.5E-01	39	3.5E+00	1k						1.0E+00	45		46
Trichlorophenol 2,4,6-	88-06-2									1.1E-02	B2	1	3.10E-06	1		45	1.1E-02	46
Vanadium	7440-62-2	9.0E-03	1	9.0E-03	1d	1.0E-03	3	1.0E-03	40						2.9E-04	45		46
Vinyl chloride	75-01-4	3.0E-03	1	3.0E-03	1d	1.0E-01	1	1.0E-01	40	1.4E+00	A	1	8.80E-08	1	2.9E-02	45	3.1E-02	46
Xylenes (mixed isomers)	1330-20-7	2.0E-01	1	2.0E-01	1d	1.0E-01	3	3.0E-01	1k		D	1			8.6E-02	45		48
Zinc	7440-66-6	3.0E-01	1	3.0E-01	2	1.4E-03	5	1.4E-03	40		D	1			4.0E-04	45		48

OIL OR HAZARDOUS MATERIAL	CAS	Relative Absorption Factors (RAFs)							
		Soil						Air[1]	
		Chronic Ingestion	Chronic Dermal	Subchronic Ingestion	Subchronic Dermal	Cancer Ingestion	Cancer Dermal	Subchronic Inhalation	Cancer Inhalation
Acenaphthene	83-32-9	0.36	0.1	0.36	0.1	NC	NC	1	
Acenaphthylene	208-96-8	0.36	0.1	0.36	0.1	NC	NC	1	
Acetone	67-64-1	1	0.1	1	0.1	NC	NC	1	
Aldrin	309-00-2	1	0.25	1	0.25	1	0.25	1	1
Anthracene	120-12-7	0.36	0.1	0.36	0.1	NC	NC	1	
Antimony	7440-36-0	1	0.1	1	0.1	NC	NC	1	
Arsenic	7440-38-2	1	0.03	1	0.03	1	0.03	1	1
Barium	7440-39-3	1	0.05	1	0.05	NC	NC	1	
Benzene	71-43-2	1	0.08	1	0.08	1	0.08	1	1
Benzo(a)anthracene	56-55-3	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(a)pyrene	50-32-8	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(b)fluoranthene	205-99-2	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(g,h,i)perylene	191-24-2	0.36	0.1	0.36	0.1	NC	NC	1	
Benzo(k)fluoranthene	207-08-9	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Beryllium	7440-41-7	1	0.03	1	0.03	1	0.03	1	1
Biphenyl, 1,1-	92-52-4	1	0.08	1	0.08	NC	NC	1	
Bis(2-chloroethyl)ether	111-44-4	NC	NC	NC	NC	1	1		1
Bis(2-chloroisopropyl)ether	39638-32-9	1	1	1	1	1	1	1	1
Bis(2-ethylhexyl)phthalate	117-81-7	1	0.02	1	0.02	1	0.02	1	1
Bromodichloromethane	75-27-4	1	0.1	1	0.1	1	0.1	1	1
Bromoform	75-25-2	1	0.11	1	0.11	1	0.1	1	1
Bromomethane	74-83-9	1	0.1	1	0.1	NC	NC	1	
Cadmium	7440-43-9	1	0.14	1	0.14	NC	NC	1	1
Carbon tetrachloride	56-23-5	1	0.1	1	0.1	1	0.1	1	1
Chlordane	12789-03-6	1	0.05	1	0.05	1	0.05	1	1
Chloroaniline, p-	106-47-8	1	0.1	1	0.1	NC	NC	1	
Chlorobenzene	108-90-7	1	0.1	1	0.1	NC	NC	1	
Chloroform	67-66-3	1	0.1	1	0.1			1	1
Chlorophenol, 2-	95-57-8	1	0.26	1	0.26	NC	NC	1	
Chromium (total)	7440-47-3	1	0.09	1	0.09	NC	NC	1	1
Chromium(III)	16065-83-1	1	0.04	1	0.04	NC	NC	1	
Chromium(VI)	18540-29-9	1	0.09	1	0.09	NC	NC	1	1
Chrysene	218-01-9	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Cyanide	57-12-5	1	0.3	1	0.3	NC	NC	1	
Dibenzo(a,h)anthracene	53-70-3	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Dibromochloromethane	124-48-1	1	0.1	1	0.1	1	0.1	1	1
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	1	0.1	1	0.1	NC	NC	1	
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	1	0.1	1	0.1	NC	NC	1	
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	1	0.1	1	0.1	1	0.1	1	1
Dichlorobenzidine, 3,3'-	91-94-1	NC	NC	NC	NC	1	0.54		1
DDD	72-54-8	1	0.2	1	0.2	1	0.2	1	1
DDE	72-55-9	1	0.2	1	0.2	1	0.2	1	1
DDT	50-29-3	1	0.2	1	0.2	1	0.2	1	1
Dichloroethane, 1,1-	75-34-3	1.3	0.13	1.3	0.13	NC	NC	1	

Dichloroethane, 1,2-	107-06-2	1	0.1	1	0.1	1	0.1	1	1
Dichloroethylene, 1,1-	75-35-4	1	0.1	1	0.1			1	
Dichloroethylene, cis-1,2-	156-59-2	1	0.1	1	0.1	NC	NC	1	
Dichloroethylene, trans-1,2-	156-60-5	1	0.1	1	0.1	NC	NC	1	
Dichloromethane	75-09-2	1	0.1	1	0.1	1	0.1	1	1
Dichlorophenol, 2,4-	120-83-2	1	0.4	1	0.4	NC	NC	1	
Dichloropropane, 1,2-	78-87-5	NC	NC	NC	NC	1	0.2	1	1
Dichloropropene, 1,3-	542-75-6	1	0.2	1	0.2	1	0.2	1	1
Dieldrin	60-57-1	1	0.25	1	0.25	1	0.25	1	1
Diethyl phthalate	84-66-2	1	0.07	1	0.07	NC	NC	1	
Dimethyl phthalate	131-11-3	1	0.07	1	0.07	NC	NC	1	
Dimethylphenol, 2,4-	105-67-9	1	0.26	1	0.26	NC	NC	1	
Dinitrophenol, 2,4-	51-28-5	1	0.26	1	0.26	NC	NC	1	
Dinitrotoluene, 2,4-	121-14-2	1	0.13	1	0.13	1	0.13	1	1
Dioxane, 1,4-	123-91-1	1	0.25	1	0.25	1	0.25	1	1
Endosulfan	115-29-7	1	0.2	1	0.2	NC	NC	1	
Endrin	72-20-8	1	0.25	1	0.25	NC	NC	1	
Ethylbenzene	100-41-4	1	0.2	1	0.2	NC	NC	1	
Ethylene dibromide	106-93-4	1	0.1	1	0.1	1	0.1	1	1
Fluoranthene	206-44-0	0.36	0.1	0.36	0.1	NC	NC	1	
Fluorene	86-73-7	0.36	0.1	0.36	0.1	NC	NC	1	
Heptachlor	76-44-8	1	0.2	1	0.2	1	0.2	1	1
Heptachlor epoxide	1024-57-3	1	0.2	1	0.2	1	0.2	1	1
Hexachlorobenzene	118-74-1	1	0.13	1	0.13	1	0.13	1	1
Hexachlorobutadiene	87-68-3	1	0.2	1	0.2	1	0.2	1	1
gamma-HCH	58-89-9	1	0.2	1	0.2	1	0.2	1	1
Hexachloroethane	67-72-1	1	1	1	1	1	1	1	1
Hmx	2691-41-0	1	0.2	1	0.2	NC	NC	1	
Indeno(1,2,3-cd)pyrene	193-39-5	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Lead	7439-92-1	0.5	0.006	0.5	0.006	NC	NC	1	
Mercury	7439-97-6	1	0.05	1	0.05	NC	NC	1	
Methoxychlor	72-43-5	1	0.2	1	0.2	NC	NC	1	
Methyl ethyl ketone	78-93-3	1	0.1	1	0.1	NC	NC	1	
Methyl isobutyl ketone	108-10-1	1	0.1	1	0.1	NC	NC	1	
Methyl mercury	22967-92-6	1	0.2	1	0.2	NC	NC	1	
Methyl tert butyl ether	1634-04-4	1	0.1	1	0.1	NC	NC	1	
Methylnaphthalene, 2-	91-57-6	0.36	0.1	0.36	0.1	NC	NC	1	
Naphthalene	91-20-3	0.36	0.1	0.36	0.1	NC	NC	1	
Nickel	7440-02-0	1	0.35	1	0.35	NC	NC	1	1
N-nitrosodimethylamine (NDMA)	62-75-9					1	0.2		1
Pentachlorophenol	87-86-5	1	0.11	1	0.11	1	0.11	1	1
Perchlorate	NA	1	0.2	1	0.2			1	
Petroleum hydrocarbons	NA								
Aliphatics C5 to C8	NA	1	1	1	1	NC	NC	1	
Aliphatics C9 to C12	NA	1	0.5	1	0.5	NC	NC	1	
Aliphatics C9 to C18	NA	1	0.5	1	0.5	NC	NC	1	
Aliphatics C19 to C36	NA	1	0.1	1	0.1	NC	NC		
Aromatics C9 to C10	NA	1	0.5	1	0.5	NC	NC	1	
Aromatics C11 to C22	NA	0.36	0.1	0.36	0.1	NC	NC	1	
Phenanthrene	85-01-8	0.36	0.1	0.36	0.1	NC	NC	1	

Phenol	108-95-2	1	0.26	1	0.26	NC	NC	1	
Polychlorinated biphenyls (PCBs)	1336-36-3	0.85	0.16	0.85	0.16	0.85	0.16	1	1
Pyrene	129-00-0	0.36	0.1	0.36	0.1	NC	NC	1	
Rdx	121-82-4	1	0.2	1	0.2	1	0.2	1	1
Selenium	7782-49-2	1	0.002	1	0.002	NC	NC	1	
Silver	7440-22-4	1	0.25	1	0.25	NC	NC	1	
Styrene	100-42-5	1	0.2	1	0.2	1	0.2	1	1
TCDD, 2,3,7,8- (equivalents)	1746-01-6	NC	NC	NC	NC	1	0.2		1
Tetrachloroethane, 1,1,1,2-	630-20-6	1	1.4	1	1.4	1	1.4	1	1
Tetrachloroethane, 1,1,2,2-	79-34-5	NC	NC	NC	NC	1	1.4	1	1
Tetrachloroethylene	127-18-4	1	0.1	1	0.1	1	0.1	1	1
Thallium	7440-28-0	1	0.01	1	0.01	NC	NC	1	
Toluene	108-88-3	1	0.12	1	0.12	NC	NC	1	
Trichlorobenzene, 1,2,4-	120-82-1	1	0.08	1	0.08	NC	NC	1	
Trichloroethane, 1,1,1-	71-55-6	1	0.1	1	0.1	NC	NC	1	
Trichloroethane, 1,1,2-	79-00-5	1	1	1	1	1	1	1	1
Trichloroethylene	79-01-6	1	0.1	1	0.1	1	0.1	1	1
Trichlorophenol, 2,4,5-	95-95-4	1	0.26	1	0.26	NC	NC	1	
Trichlorophenol 2,4,6-	88-06-2	NC	NC	NC	NC	1	0.26		1
Vanadium	7440-62-2	1	0.03	1	0.03	NC	NC	1	
Vinyl chloride	75-01-4	1	0.1	1	0.1	1.53	0.16	1	1
Xylenes (mixed isomers)	1330-20-7	1	0.12	1	0.12	NC	NC	1	
Zinc	7440-66-6	1	0.02	1	0.02	NC	NC	1	
zzTriMethylbenzene, 1,3,5-	108-67-8	1	1	1	1	1	1	1	1
zzzTriMethylbenzene, 1,2,4-	95-63-6	1	1	1	1	1	1	1	1
zzzzButylbenzene	104-51-8	1	1	1	1	1	1	1	1

1: Default values. If there is no Reference Concentration, a non-cancer inhalation RAF was not implied. If there is no Inhalation Unit Risk, a cancer inhalation RAF was n

OIL OR HAZARDOUS MATERIAL	CAS	Relative Absorption Factors (RAFs) Water Subchronic Ingestion	Water Chronic Ingestion	Water Cancer Ingestion	Produce Noncancer Ingestion	Produce Cancer Ingestion	Oral Absorption Efficiency Tox Study OAEnoncance	Oral Absorption Efficiency Tox Study OAEcancer	Outside Effective Predictive Domain	Fraction Absorbed[1] FA
Acenaphthene	83-32-9	1	1				0.92	NC		1
Acenaphthylene	208-96-8	0.91	0.91				0.92	NC	*	1
Acetone	67-64-1	1	1				1	NC		1
Aldrin	309-00-2	1	1	1			0.8	0.8		1
Anthracene	120-12-7	1	1				0.92	NC	*	1
Antimony	7440-36-0	1	1				0.1	NC		1
Arsenic	7440-38-2	1	1	1	1	1	0.98	0.98		1
Barium	7440-39-3	1	1				0.91	NC		1
Benzene	71-43-2	1	1	1			1	1		1
Benzo(a)anthracene	56-55-3	0.91	0.91	1			0.92	0.92	*	1
Benzo(a)pyrene	50-32-8	0.91	0.91	1			0.92	0.92	*	1
Benzo(b)fluoranthene	205-99-2	0.91	0.91	1			0.92	0.92	*	1
Benzo(g,h,i)perylene	191-24-2	0.91	0.91				0.92	NC	*	1
Benzo(k)fluoranthene	207-08-9	0.91	0.91	1			0.92	0.92	*	1
Beryllium	7440-41-7	1	1	1			0.01	0.01		1
Biphenyl, 1,1-	92-52-4	1	1				1	NC		1
Bis(2-chloroethyl)ether	111-44-4			1				0.98		1
Bis(2-chloroisopropyl)ether	39638-32-9	1	1	1			0.98	0.98		1
Bis(2-ethylhexyl)phthalate	117-81-7	1	1	1			1	1	*	0.8
Bromodichloromethane	75-27-4	1	1	1			0.98	0.98		1
Bromoform	75-25-2	1	1	1			0.9	0.9		1
Bromomethane	74-83-9	1	1				0.97	NC		1
Cadmium	7440-43-9	1	1		1		0.07	NC		1
Carbon tetrachloride	56-23-5	1	1	1			1	1		1
Chlordane	12789-03-6	1	1	1	0.91	1	0.8	0.8	*	0.7
Chloroaniline, p-	106-47-8	1	1				1	NC		1
Chlorobenzene	108-90-7	1	1				1	NC		1
Chloroform	67-66-3	1	1				1	1		1
Chlorophenol, 2-	95-57-8	1	1				1	NC		1
Chromium (total)	7440-47-3	1	1		1		0.11	NC		1
Chromium(III)	16065-83-1	1	1		1		0.25	NC		1
Chromium(VI)	18540-29-9	1	1		1		0.11	NC		1
Chrysene	218-01-9	0.91	0.91	1			0.92	0.92	*	1
Cyanide	57-12-5	1	1				1	NC		1

Dibenzo(a,h)anthracene	53-70-3	0.91	0.91	1		0.92	0.92	*	0.6
Dibromochloromethane	124-48-1	1	1	1		0.98	0.98		1
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	1	1			1	NC		1
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	1	1			1	NC		1
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	1	1	1		1	1		1
Dichlorobenzidine, 3,3'-	91-94-1		1	1		0.9	0.9		1
DDD	72-54-8	1		1	1	0.9	0.6	*	0.8
DDE	72-55-9	1		1	1	0.9	0.6	*	0.8
DDT	50-29-3	1	1	1		0.9	0.6	*	0.7
Dichloroethane, 1,1-	75-34-3	1.3	1.3			0.75	NC		1
Dichloroethane, 1,2-	107-06-2	1	1	1		1	1		1
Dichloroethylene, 1,1-	75-35-4	1	1			1	0.98		1
Dichloroethylene, cis-1,2-	156-59-2	1	1			0.84	NC		1
Dichloroethylene, trans-1,2-	156-60-5	1	1			0.84	NC		1
Dichloromethane	75-09-2	1	1	1		1	1		1
Dichlorophenol, 2,4-	120-83-2	1	1			1	NC		1
Dichloropropane, 1,2-	78-87-5			1		1	1		1
Dichloropropene, 1,3-	542-75-6	1	1	1		1	1		1
Dieldrin	60-57-1	1	1	1		0.8	0.8	*	0.8
Diethyl phthalate	84-66-2	1	1			1	NC		1
Dimethyl phthalate	131-11-3	1	1			1	NC		1
Dimethylphenol, 2,4-	105-67-9	1	1			1	NC		1
Dinitrophenol, 2,4-	51-28-5	1	1			1	NC		1
Dinitrotoluene, 2,4-	121-14-2	1	1	1		0.9	0.9		1
Dioxane, 1,4-	123-91-1	1	1	1		1	1		1
Endosulfan	115-29-7	1	1			1	NC	*	1
Endrin	72-20-8	1	1			0.8	NC	*	0.8
Ethylbenzene	100-41-4	1	1			1	NC		1
Ethylene dibromide	106-93-4	1	1	1		1	1		1
Fluoranthene	206-44-0	1	1			0.92	NC	*	1
Fluorene	86-73-7	1	1			0.92	NC	*	1
Heptachlor	76-44-8	1	1	1		0.66	0.66	*	0.8
Heptachlor epoxide	1024-57-3	1	1	1		0.66	0.66	*	1
Hexachlorobenzene	118-74-1	1	1	1		0.8	0.8	*	0.9
Hexachlorobutadiene	87-68-3	1	1	1		1	1	*	0.9
gamma-HCH	58-89-9	1	1	1		1	1		0.9
Hexachloroethane	67-72-1	1	1	1		1	1		1
Hmx	2691-41-0	1	1			0.3	NC		1
Indeno(1,2,3-cd)pyrene	193-39-5	0.91	0.91	1		0.92	0.92	*	0.6
Lead	7439-92-1	0.5	0.5		0.5	0.5	NC		1

Mercury	7439-97-6	1	1				0.95	NC		1
Methoxychlor	72-43-5	1	1				1	NC	*	1
Methyl ethyl ketone	78-93-3	1	1				1	NC		1
Methyl isobutyl ketone	108-10-1	1	1				1	NC		1
Methyl mercury	22967-92-6	1	1				0.95	NC		1
Methyl tert butyl ether	1634-04-4	1	1				1			1
Methylnaphthalene, 2-	91-57-6	1	1				0.92	NC		1
Naphthalene	91-20-3	1	1				0.92	NC		1
Nickel	7440-02-0	1	1			1	0.1	NC		1
N-nitrosodimethylamine (NDMA)	62-75-9			1				1		1
Pentachlorophenol	87-86-5	1	1		1		0.9	0.9	*	0.9
Perchlorate	NA	1	1			1	1			1
Petroleum hydrocarbons	NA									
Aliphatics C5 to C8	NA	1	1				1	NC		1
Aliphatics C9 to C12	NA	1	1				1	NC	*	1
Aliphatics C9 to C18	NA	1	1				1	NC	*	1
Aliphatics C19 to C36	NA	1	1				1	NC	*	1
Aromatics C9 to C10	NA	0.91	0.91				0.92	NC		1
Aromatics C11 to C22	NA	0.91	0.91				0.92	NC	*	1
Phenanthrene	85-01-8	0.91	0.91				0.92	NC	*	1
Phenol	108-95-2	1	1				1	NC		1
Polychlorinated biphenyls (PCBs)	1336-36-3	1	1	1	1	1	0.89	0.89	*	0.5
Pyrene	129-00-0	1	1				0.92	NC	*	1
Rdx	121-82-4	1	1	1			1	1		1
Selenium	7782-49-2	1	1				0.6	NC		1
Silver	7440-22-4	1	1				0.04	NC		1
Styrene	100-42-5	1	1	1			1	1		1
TCDD, 2,3,7,8- (equivalents)	1746-01-6			1			1	1	*	0.5
Tetrachloroethane, 1,1,1,2-	630-20-6	1	1	1			0.7	0.7		1
Tetrachloroethane, 1,1,2,2-	79-34-5			1				0.7		1
Tetrachloroethylene	127-18-4	1	1	1			1	1		1
Thallium	7440-28-0	1	1				1	NC		1
Toluene	108-88-3	1	1				1	NC		1
Trichlorobenzene, 1,2,4-	120-82-1	1	1				1	NC		1
Trichloroethane, 1,1,1-	71-55-6	1	1				1	NC		1
Trichloroethane, 1,1,2-	79-00-5	1	1	1			1	1		1
Trichloroethylene	79-01-6	1	1	1			1	1		1
Trichlorophenol, 2,4,5-	95-95-4	1	1				1	NC		1
Trichlorophenol 2,4,6-	88-06-2			1			1	1		1
Vanadium	7440-62-2	1	1				0.05	NC		1

Vinyl chloride	75-01-4	1	1	1.53			0.98	0.64			1
Xylenes (mixed isomers)	1330-20-7	1	1				1	NC			1
Zinc	7440-66-6	1	1		1		0.46	NC			1
zzTriMethylbenzene, 1,3,5-	108-67-8	1	1	1		1	1		1		1
zzzTriMethylbenzene, 1,2,4-	95-63-6	1	1	1		1	1		1		1
zzzzButylbenzene	104-51-8	1	1	1	1		1	1			1

[1] U.S. EPA (2001) Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim (http://www.epa.gov/superfund/programs/risk/ragse/). Appendix B (Exhibit B-3).

OIL OR HAZARDOUS MATERIAL		Molecular Weight g/mole	log K_{ow}	Permeability Coefficient Kp^{1} cm/hr	Henry's Law Constant HLC atm-m3/mol	Metal	Plant Uptake Factor Ksp mg-soil/mg-plant	Outside Effective Predictive Domain	Diffusivity in air, Da (cm^2/s)	REF	Diffusivity in water, Dw (cm^2/s)	REF
Acenaphthene	83-32-9	154	3.92	8.410E-02	1.84E-04				4.21E-02	6	7.69E-06	6
Acenaphthylene	208-96-8	154	4.07	1.056E-01	1.14E-04			*	4.39E-02	47	7.07E-06	48
Acetone	67-64-1	58	-0.24	5.210E-04	3.97E-05				1.24E-01	6	1.14E-05	6
Aldrin	309-00-2	365	3.01	1.389E-03	4.40E-05				1.32E-02	6	4.86E-06	6
Anthracene	120-12-7	178	4.55	1.608E-01	5.56E-05			*	3.24E-02	6	7.74E-06	6
Antimony	7440-36-0	122		1.000E-03		yes						
Arsenic	7440-38-2	75		1.000E-03		yes	0.05					
Barium	7440-39-3	137		1.000E-03		yes						
Benzene	71-43-2	78	2.13	1.476E-02	5.55E-03				8.80E-02	6	9.80E-06	6
Benzo(a)anthracene	56-55-3	228	5.66	4.558E-01	1.20E-05			*	5.10E-02	6	9.00E-06	6
Benzo(a)pyrene	50-32-8	252	6.1	6.528E-01	4.57E-07			*	4.30E-02	6	9.00E-06	6
Benzo(b)fluoranthene	205-99-2	252	6.12	6.730E-01	6.57E-07			*	2.26E-02	6	5.56E-06	6
Benzo(g,h,i)perylene	191-24-2	276	6.51	8.933E-01	3.31E-07			*	4.90E-02	47	5.65E-05	48
Benzo(k)fluoranthene	207-08-9	252	6.06	6.143E-01	5.84E-07			*	2.26E-02	6	5.56E-06	6
Beryllium	7440-41-7	9		1.000E-03		yes						
Biphenyl, 1,1-	92-52-4	154	4.09	1.089E-01	3.08E-04				5.73E-02	47	6.71E-06	48
Bis(2-chloroethyl)ether	111-44-4	143	1.29	1.781E-03	1.70E-05				6.92E-02	47	7.53E-06	48
Bis(2-chloroisopropyl)ether	39638-32-9	171	2.1	4.250E-03	3.32E-04				6.00E-02	6	6.40E-06	6
Bis(2-ethylhexyl)phthalate	117-81-7	391	5.11	2.415E-02	2.70E-07			*	3.51E-02	6	3.66E-06	6
Bromodichloromethane	75-27-4	164	2.09	4.581E-03	2.12E-03				2.98E-02	6	1.06E-05	6
Bromoform	75-25-2	253	2.37	2.225E-03	5.35E-04				1.49E-02	6	1.03E-05	6
Bromomethane	74-83-9	95			7.34E-03				7.28E-02	6	1.21E-05	6
Cadmium	7440-43-9	112		1.000E-03		yes	1.9					
Carbon tetrachloride	56-23-5	154	2.83	1.605E-02	2.76E-02				7.80E-02	6	8.80E-06	6
Chlordane	12789-03-6	410	5.54	3.634E-02	7.03E-05		11	*	1.18E-02	6	4.37E-06	6
Chloroaniline, p-	106-47-8	128	1.85	5.061E-03	1.16E-06				4.83E-02	6	1.01E-05	6
Chlorobenzene	108-90-7	113	2.84	2.764E-02	3.11E-03				7.30E-02	6	8.70E-06	6
Chloroform	67-66-3	119	1.97	6.820E-03	3.67E-03				1.04E-01	6	1.00E-05	6
Chlorophenol, 2-	95-57-8	129	2.16	8.002E-03	1.12E-05				5.01E-02	6	9.46E-06	6
Chromium (total)	7440-47-3	52		2.000E-03		yes	0.095					
Chromium(III)	16065-83-1	52		1.000E-03		yes	0.095					
Chromium(VI)	18540-29-9	52		2.000E-03		yes	0.095					
Chrysene	218-01-9	228	5.66	4.558E-01	5.23E-06			*	2.48E-02	6	6.21E-06	6
Cyanide	57-12-5	27		1.000E-03	2.42E-02	yes						
Dibenzo(a,h)anthracene	53-70-3	278	6.84	1.437E+00	1.23E-07			*	2.02E-02	6	5.18E-06	6
Dibromochloromethane	124-48-1	208	2.17	2.934E-03	7.83E-04				1.96E-02	6	1.05E-05	6
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	147	3.38	4.051E-02	1.92E-03				6.90E-02	6	7.90E-06	6
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	147	3.6	5.660E-02	2.63E-03				6.80E-02	6	8.13E-06	6
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	147	3.39	4.113E-02	2.41E-03				6.90E-02	6	7.90E-06	6
Dichlorobenzidine, 3,3'-	91-94-1	253	3.51	1.258E-02	2.84E-11				1.94E-02	6	6.74E-06	6
DDD	72-54-8	320	5.8	1.722E-01	6.60E-06			*	1.69E-02	6	4.76E-06	6
DDE	72-55-9	318	5.69	1.495E-01	4.16E-05			*	1.44E-02	6	5.87E-06	6

DDT	50-29-3	354	6.36	2.601E-01	8.32E-06			*	1.37E-02	6	4.95E-06	6
Dichloroethane, 1,1-	75-34-3	99	1.79	6.714E-03	5.62E-03				7.42E-02	6	1.05E-05	6
Dichloroethane, 1,2-	107-06-2	99	1.48	4.192E-03	1.18E-03				1.04E-01	6	9.90E-06	6
Dichloroethylene, 1,1-	75-35-4	97	2.13	1.155E-02	2.61E-02				9.00E-02	6	1.04E-05	6
Dichloroethylene, cis-1,2-	156-59-2	97	1.86	7.663E-03	4.08E-03				7.36E-02	6	1.13E-05	6
Dichloroethylene, trans-1,2-	156-60-5	97	1.86	7.663E-03	9.38E-03				7.07E-02	6	1.19E-05	6
Dichloromethane	75-09-2	85	1.25	3.540E-03	3.25E-03				1.01E-01	6	1.17E-05	6
Dichlorophenol, 2,4-	120-83-2	163	2.92	1.638E-02	5.51E-06				3.46E-02	6	8.77E-06	6
Dichloropropane, 1,2-	78-87-5	113	2	7.713E-03	2.82E-03				7.82E-02	6	8.73E-06	6
Dichloropropene, 1,3-	542-75-6	111	1.6	4.309E-03	3.55E-03				6.26E-02	6	1.00E-05	6
Dieldrin	60-57-1	381	4.56	1.191E-02	1.00E-05			*	1.25E-02	6	4.74E-06	6
Diethyl phthalate	84-66-2	222	2.47	3.864E-03	6.10E-07				2.56E-02	6	6.35E-06	6
Dimethyl phthalate	131-11-3	194	1.56	1.391E-03	1.97E-07				5.68E-02	47	6.30E-06	48
Dimethylphenol, 2,4-	105-67-9	122	2.3	1.083E-02	9.51E-07				5.84E-02	6	8.69E-06	6
Dinitrophenol, 2,4-	51-28-5	184	1.55	1.558E-03	8.60E-08				2.73E-02	6	9.06E-06	6
Dinitrotoluene, 2,4-	121-14-2	182	1.98	3.073E-03	5.40E-08				2.03E-01	6	7.06E-06	6
Dioxane, 1,4-	123-91-1	88	-0.32	3.133E-04	4.80E-06				2.30E-01	47	1.00E-05	48
Endosulfan	115-29-7	407	4.1	4.234E-03	6.50E-05			*	1.15E-02	6	4.55E-06	6
Endrin	72-20-8	381	4.56	1.191E-02	6.36E-06			*	1.25E-02	6	4.74E-06	6
Ethylbenzene	100-41-4	106	3.15	4.846E-02	7.88E-03				7.50E-02	6	7.80E-06	6
Ethylene dibromide	106-93-4	188	1.96	2.759E-03	6.50E-04				2.17E-02	47	1.90E-05	48
Fluoranthene	206-44-0	202	4.95	2.167E-01	8.86E-06			*	3.02E-02	6	6.35E-06	6
Fluorene	86-73-7	166	4.21	1.119E-01	9.62E-05			*	3.63E-02	6	7.88E-06	6
Heptachlor	76-44-8	374	4.27	8.391E-03	2.94E-04			*	1.12E-02	6	5.69E-06	6
Heptachlor epoxide	1024-57-3	389	5	2.097E-02	2.10E-05			*	1.32E-02	6	4.23E-06	6
Hexachlorobenzene	118-74-1	285	5.31	1.284E-01	1.70E-03			*	5.42E-02	6	5.91E-06	6
Hexachlorobutadiene	87-68-3	261	4.78	7.820E-02	1.03E-02			*	5.61E-02	6	6.16E-06	6
gamma-HCH	58-89-9	291	3.73	1.077E-02	5.14E-06				1.42E-02	6	7.34E-06	6
Hexachloroethane	67-72-1	237	3.93	2.928E-02	3.89E-03				2.50E-03	6	6.80E-06	6
Hmx	2691-41-0	296.2	0.26	5.163E-05	8.67E-10				4.30E-02	47	4.95E-06	48
Indeno(1,2,3-cd)pyrene	193-39-5	276	6.58	9.936E-01	3.48E-07			*	1.90E-02	6	5.66E-06	6
Lead	7439-92-1	207		1.000E-04		yes	0.15					
Mercury	7439-97-6	201		1.000E-03		yes			3.07E-02	6	6.30E-06	6
Methoxychlor	72-43-5	346	5.08	4.123E-02	2.03E-07			*	1.56E-02	6	4.46E-06	6
Methyl ethyl ketone	78-93-3	72	0.29	9.732E-04	5.69E-05				8.08E-02	47	9.80E-06	48
Methyl isobutyl ketone	108-10-1	100	1.19	2.663E-03	1.38E-04				7.50E-02	47	7.80E-06	48
Methyl mercury	22967-92-6	231		1.000E-03		yes			5.30E-02	47	6.10E-06	48
Methyl tert butyl ether	1634-04-4	88	1.05	2.513E-03	5.87E-04				2.37E-03	47	8.63E-06	48
Methylnaphthalene, 2-	91-57-6	142	3.86	8.962E-02	5.18E-04				6.29E-02	47	7.20E-06	48
Naphthalene	91-20-3	128	3.3	4.584E-02	4.40E-04				5.90E-02	6	7.50E-06	6
Nickel	7440-02-0	59		2.000E-04		yes	0.38					
N-nitrosodimethylamine (NDMA)	62-75-9	74.0822	-0.57	2.564E-04	1.82E-06				1.13E-01	44	1.24E-05	44
Pentachlorophenol	87-86-5	266	5.86	3.784E-01	2.45E-08			*	5.60E-02	6	6.10E-06	6
Perchlorate	NA			0.000E+00								
Petroleum hydrocarbons	NA											
Aliphatics C5 to C8	NA	93	3.85	1.660E-01	1.296				8.00E-02		1.00E-06	6
Aliphatics C9 to C12	NA	149	5.52	1.020E+00	1.56			*	7.00E-02		1.00E-06	6

Aliphatics C9 to C18	NA	170	5.94	1.474E+00	1.656			*	7.00E-02		5.00E-06	6
Aliphatics C19 to C36	NA		11	0.000E+00				*				
Aromatics C9 to C10	NA	120	3.93	1.324E-01	0.00792				7.00E-02		1.00E-06	6
Aromatics C11 to C22	NA	150	5.09	5.241E-01	0.00072			*	6.00E-02		1.00E-06	6
Phenanthrene	85-01-8	178	4.46	1.402E-01	4.23E-05			*	3.33E-02	47	7.47E-06	48
Phenol	108-95-2	94	1.46	4.337E-03	3.33E-07				8.20E-02	6	9.10E-06	6
Polychlorinated biphenyls (PCBs)	1336-36-3	328	6.72	6.286E-01	4.15E-04		0.84	*	1.38E-02	47	4.32E-06	48
Pyrene	129-00-0	202	5.11	2.763E-01	1.19E-05			*	2.72E-02	6	7.24E-06	6
Rdx	121-82-4	222.26	0.87	3.385E-04	6.32E-08				5.20E-02	47	6.00E-06	48
Selenium	7782-49-2	79		1.000E-03		yes						
Silver	7440-22-4	108		6.000E-04		yes						
Styrene	100-42-5	104	2.95	3.669E-02	2.75E-03				7.10E-02	6	8.00E-06	6
TCDD, 2,3,7,8- (equivalents)	1746-01-6	322	6.8	7.670E-01	5.00E-05			*	4.70E-02	6	8.00E-06	6
Tetrachloroethane, 1,1,1,2-	630-20-6	168	3.03	1.816E-02	2.45E-03				7.10E-02	47	7.90E-06	48
Tetrachloroethane, 1,1,2,2-	79-34-5	168	2.39	6.864E-03	3.67E-04				7.10E-02	6	7.90E-06	6
Tetrachloroethylene	127-18-4	166	3.4	3.269E-02	1.77E-02				7.20E-02	6	8.20E-06	6
Thallium	7440-28-0	204		1.000E-03		yes						
Toluene	108-88-3	92	2.73	3.066E-02	6.64E-03				8.70E-02	6	8.60E-06	6
Trichlorobenzene, 1,2,4-	120-82-1	181	3.98	6.504E-02	1.42E-03				7.80E-02	6	8.80E-06	6
Trichloroethane, 1,1,1-	71-55-6	133	2.49	1.255E-02	1.72E-02				7.80E-02	6	8.80E-06	6
Trichloroethane, 1,1,2-	79-00-5	133	2.05	6.430E-03	8.24E-04				7.80E-02	6	8.80E-06	6
Trichloroethylene	79-01-6	131	2.42	1.158E-02	9.85E-03				7.90E-02	6	9.10E-06	6
Trichlorophenol, 2,4,5-	95-95-4	197	3.9	4.686E-02	1.62E-06				2.91E-02	6	7.03E-06	6
Trichlorophenol 2,4,6-	88-06-2	197	3.69	3.406E-02	2.60E-06				3.18E-02	6	6.25E-06	6
Vanadium	7440-62-2	51		1.000E-03		yes						
Vinyl chloride	75-01-4	63	1.36	5.556E-03	2.78E-02				1.06E-01	6	1.23E-06	6
Xylenes (mixed isomers)	1330-20-7	106	3.2	5.229E-02	6.63E-03				7.69E-02	6	8.44E-06	6
Zinc	7440-66-6	65		6.000E-04		yes	1.5					
zzTriMethylbenzene, 1,3,5-	108-67-8	120.2	3.7	9.309E-02	0.00877				0.0602254	6	7.843E-06	6
zzzTriMethylbenzene, 1,2,4-	95-63-6	120.2	3.7	9.309E-02	0.00616				0.0606754	6	7.9209E-06	6
zzzzButylbenzene	104-51-8	134.22	4.29	1.904E-01	0.0159				0.0527732	6	7.3335E-06	6

[1] U.S. EPA (2001) Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim (http://www.epa.gov/superfund/programs/risk/ragse/). Chapter 3 for metals, Appendix B (Exhibit B-2) for organics.

References used in calculating Method 3 Risk

Reference #	Description
1	U.S. EPA, Integrated Risk Information System (IRIS). On-line search: current as of January 10, 2007.
1a	The oral cancer slope factor for a mix of 2,4- and 2,6- Dinitrotoluene (from IRIS) has been used as the cancer slope factor equivalent for pure 2,4-Dinitrotoluene.
1b	The chronic oral RfD for 1,2-Dichlorobenzene has been used as the chronic oral RfD equivalent for 1,3-Dichlorobenzene and 1,4-Dichlorobenzene.
1c	IRIS lists two oral RfDs, one for food and one for water exposure. The more conservative is used here.
1d	The chronic oral RfD (from IRIS) has been used here as a subchronic oral RfD equivalent.
1e	This Cancer Slope Factor or Unit Risk for benzo(a)pyrene (from IRIS) has been applied to the seven PAH compounds which are designated as category A, B1, B2 or C carcinogens.
1f	This value (Be Oral CSF of 4.3 kg-day/mg) was recently withdrawn form IRIS, although many consultants may continue to use it, lacking any new information.
1g	The chronic oral Reference Dose for DDT has been adopted for DDD and DDE as well.
1h	The chronic RfC for Cr VI was used for CR III rather than the old, withdrawn HEAST value of 2E-6 mg/m3, which would imply that Cr III is 50 times more toxic than Cr VI.
1i	The subchronic RfD is based upon the subchronic toxicity data that is the basis of the chronic RfD presented in the IRIS file.
1j	The subchronic RfC is set equal to the chronic RfC based on information about subchronic toxicity presented in the IRIS file.
1k	The subchronic RfC is set equal to a multiple (often, but not always 10) of the chronic RfC based on information about subchronic toxicity presented in the IRIS file.
2	U.S. EPA Health Effects Assessment Summary Tables (HEAST), Annual FY-1992. (OERR 9200.6-303 (92-1), NTIS No. PB92-921199) January/July 1992.
2a	This subchronic oral RfD (from HEAST) for 1,2-Dichlorobenzene has been used as the subchronic oral RfD equivalent for 1,3- and 1,4- Dichlorobenzene.
2b	The subchronic RfC is set equal to a multiple (often, but not always 10) of the chronic RfC based on information about subchronic toxicity presented in HEAST.
2c	This Cancer Slope Factor or Unit Risk was taken from a fact sheet distributed by the U.S. EPA Superfund Health Risk Technical Support Center at ECAO-Cincinnati, current as of September 2, 1992.
2d	This value has been withdrawn from HEAST, although many consultants may continue to use it, lacking any new information. Consult HEAST for any additional information.
2e	from Table 2 of HEAST, calculated by an alternative method.
2f	The chronic Reference Concentration for 1,2-dichlorobenzene has been used for 1,3 dichlorobenzene.
2g	The subchronic oral RfD for DDT has been adopted for DDE and DDD as well.
3	CHEM/AAL
4	Developed for the Risk Assessment ShortForm - Residential Scenario (MA DEP, 1992) by MA DEP staff. Documentation of this value may be found in that document.
4a	This one-time allowable intake for cyanide was developed by MA DEP staff. See documentation on-line at http://www.state.ma.us/dep/ors/files/cn_soil.htm
5	This value was developed by MA DEP ORS Air/Water Toxics staff.
6	US EPA Soil Screening Guidance: Technical Background Document, EPA/540/R95/128, May 1996
6a	Measured Koc from the SSL Guidance, Table 39
6b	Calculated Koc from the SSL Guidance, Table 39
10	Owen, 1990. "Literature Derived Absorption Coefficients for 39 Chemicals via Oral and Inhalation Routes of Exposure"; Regulatory Toxicology and Pharmacology; pp. 237-252; November, 1990.
11	United States Environmental Protection Agency (USEPA), 1986. "Superfund Public Health Evaluation Manual"; U.S. Environmental Protection Agency ; Office of Emergency and Remedial Response, EPA/540/1-86/060 (OSWER Directive 9285.4-1); Washington, D.C., Oct
12	USEPA, 1992. "Dermal Exposure Assessment: Principles and Applications"; U.S. Environmental Protection Agency; Office of Research and Development, EPA/600/8-91/011B; Washington, D.C., January 1992.
13	ATSDR, "Toxicological Profile for _____"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. The ATSDR profile for the chemical of interest was used as a source of this value.
14.a. - 14.l	USEPA Test Methods for Evaluating Solid Waste, SW-846, Third Edition (Revision O), November 1986.
15.a. - 15.d.	Guide to Environmental Analytical Methods, Robert E. Wagner, editor; Genium Publishing Corporation, Schenectady, NY; 1992.
16	From CLP Statement of Work for Inorganic Analytes, 8/90, Document Number ILM01.1
17	Standard Methods for the Examination of Water and Wastewater, 17th edition; Water Environment Federation.
18	Federal Register 40 CFR 141:23:3579 (January 30, 1991).
19	USEPA Method 1613.
20	U.S. Department of Defense, 1989
21	U.S. EPA Draft Health Advisory for Methyl t-Butyl Ether, 1989.
22	Oregon Department of Environmental Quality, Development of Generic Soil Cleanup Levels Based On Analysis Of The Leachate Pathway, May 12, 1992.
23	See Appendix G: Application of SESOIL Model
24	Handbook of Environmental Data on Organic Chemicals, 2nd edition, Karel Verschueren; Van Nostrand Reinhold Co. Inc., NY; 1983. Reference #
25	Compilation of Odor and Taste Threshold Values Data, F.A. Fazzalari, editor; ASTM Data Service DS48A; 1978.

References used in calculating Method 3 Risk

Reference #	Description
27	USEPA, 1992. "Reference Guide to Odor Thresholds for Hazardous Air Pollutants Listed in the Clean Air Act Amendment of 1990", U.S. Environmental Protection Agency; Office of Research and Development, EPA/600/R-92/047; Washington, D.C., March 1992.
28	USEPA, 1992. "Indoor Air Quality Database for Organic Compounds", U.S. Environmental Protection Agency; Research Triangle Park, NC, February 1992.
29	Risk Reduction Engineering Laboratory (RREL) Treatability Database, Version 4.0.
30	U.S. Department of Defense, 1991. "Defense Priority Model Users Manual", FY 1992 version; Washington, D.C.
31	Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MassDEP VPH/EPH Approach (MassDEP, 2002) Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology (MassDEP, November 2003).
32	Chemical Health Effects Assessment Methodology and the Method to Derive Allowable Ambient Limits (CHEM/AAL). ORS Report 90-1.
33	OSHA Documentation of TLV -TWA
34	from a summary table in Tsedash Zewdie
35	Conversion of the oral Cancer Slope Factor to the Inhalation Unit Risk, using the equation: Slope Factor x Ventilation Rate x Constant / Body Weight (CSF x V x C)/BW = (CSF x 20 m^3/day x 0.001 mg/µg) / 70 kg
36	From Texas NRCC document for soil standards
37	Training Workshop for Massachusetts Certified Laboratories - Handout Material - MA DEPDivision of Environmental Analysis, Wall Experiment Station (8/21/95)
38	Koc for 1,1-Biphenyl from Montgomery (Andrew Friedmann, ORS)
39	Conversion of the oral Reference Dose to a Reference Concentration, using the equation: RfD x BW / Ventilation Rate (RfD x BW) / VR = RfD x 70 kg / (20 m^3/day)
40	The Subchronic Inhalation Reference Concentration for this chemical is taken to be equal to the chronic value, absent clear chemical-specific information justifying a higher value..
41	MA DEP (2004) Perchlorate Toxicological Profile And Health Assessment. (http://www.mass.gov/dep/ors/files/chemical.htm)
42	http://chemfinder.cambridgesoft.com
43	http://esc.syrres.com
44	Toxicity value consistent with approach presented in "Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology" MA DEP 2003 and "Characterizing Risks Posed by Petroleum Contaminated Sites" MA DEP 2002.
45	Conversion of the subchronic Reference Concentration to a subchronic Inhalation Reference Dose using the equation: RfC x Ventilation Rate/ Body Weight (RfC x BW) / V = (RfC x 70 kg) / 20 m^3/day
46	Conversion of the Inhalation Unit Risk Factor to an Inhalation Cancer Slopoe Facotr using the equation: URF x Conversion Factor x Body Weight / Ventilation Rate (URF x CF x V) / BW = (URF x 1000 x 20 m^3/day) / 70 kg
47	Calculated according to the FSG Method presented in Chapter 17 of "The Handbook of Chemical Property Estimation Methods" by WJ Lyman, WF Reehl, and DH Rosenblatt, 1982.
48	Calculated according to the Hayduk-Laudie Method presented in Chapter 17 of "The Handbook of Chemical Property Estimation Methods" by WJ Lyman, WF Reehl, and DH Rosenblatt, 1982.
AL	Action Level in drinking water. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
MMCL	Massachusetts Maximum Contaminant Level in drinking water. 310 CMR 22. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
SMCL	Secondary Maximum Contaminant Level in drinking water. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
NA	Not Available
NC	Not Calculated.
ORSGL	Massachusetts DEP Drinking Water Guideline developed by the Office of Research and Standards for the Drinking Water Program. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines

Body Weight Calculations:

Age (years)	50th Percentile Body Weight Females kg	number of years		
1<2	10.7	1		
2<3	12.7	1		
3<4	14.7	1		
4<5	16.7	1		
5<6	19	1		
6<7	21.3	1	Average	
7<8	23.8	1	1-8:	17.0 kg
8<9	27.5	1		
9<10	29.7	1		
10<11	34.5	1		
11<12	40.3	1		
12<13	45.4	1		
13<14	49	1	Average	
14<15	53.1	1	8-15:	39.9 kg
15<16	53.3	1		
16<17	55.6	1		
17<18	58.4	1		
18<25	58	7	Average	
25<31	80.9	6	15 - 30:	58.7 kg
25<35	60.9	10	Average	
35-45	63.4	10	18<45:	61.1 kg

Surface Area/Adherence Factor Calculations (S-1):

Age (years)	years	Head cm2	Face (1/3 of head) cm2	Face Soil Adherence mg/cm2	Forearms cm2	Forearms Soil Adherence mg/cm2	Hands cm2	Hands Soil Adherence mg/cm2	Lower Legs cm2	Lower Legs Soil Adherence mg/cm2	Feet cm2	Feet Soil Adherence mg/cm2	
1<2	1	855.2	282.216		305.8		274.7		481		326.5		
2<3	1	822.2	271.326		341.6		306.9		537.3		411.1		
3<4	1	882.6	291.258		467.3		395.9		697.8		467.3		
4<5	1	974.3	321.519		494.2		402.4		785.1		515.4		
5<6	1	1075	354.75		545.3		444		866.2		568.7		
6<7	1	1104.3	364.419		552.2		396.2		913.8		581.7		
7<8	1	1201.3	396.429		600.6		431		994		632.7		Adherence Factor
1<8	7	988	326	0.006	472	0.027	379	1.5	754	0.2	500	0.26	0.35
8<9	1	1310	432.3		655		470		1084		690		
9<10	1	1272	419.76		651.9		561.8		1216.9		805.6		
10<11	1	1404	463.32		719.6		620.1		1343.2		889.2		
11<12	1	1560	514.8		799.5		689		1492.4		988		
12<13	1	1223.6	403.788		959		756		1708		980		
13<14	1	1475.6	486.948		895.4		754.8		1894.4		1184		
14<15	1	1545.4	509.982		937.8		790.5		1984		1240		Adherence Factor
8<15	7	1399	462	0.0574	803	0.082	663	0.318	1532	0.0419	968	0.26	0.14
15<16	1	1249.7	412.401		949.9		800.7		2009.6		1256		
16<17	1	1273.6	420.288		1048		912		2150.4		1104		
17<18	1	1297.5	428.175		1426.3		831.3		2008.2		1189.9		
18<25	7	1110	366.3		1150		817		2180		1140		
25<31	6	1110	366.3		1150		817		2180		1140		Adherence Factor
18<31	16	1141	376	0.0574	1148	0.082	823	0.318	2157	0.0419	1148	0.2563	0.13

APPENDIX J

MassDEP METHOD 3 SHORTFORM RISK CHARACTERIZATION

FOR URBAN FILL AT RTN 3-23606

EXCLUSIVE OF RTN 3-28545 AND RTN 3-28546

CLEAN PROPERTIES, INC., 111 Boston Post Road, Suite 211, Sudbury, MA 01776
Phone: 978-443-6622 Fax: 781-577-1510 Email: Public@CleanProperties.com

Method 3 Risk Assessment for Resident Exposed to Chemicals in Soil - Shortform 2006 (sf06rs)

Index

Tab		
EPCs	Table RS-1:	Select chemicals and enter Exposure Point Concentrations (EPCs). Associated risks are shown to the right.
C Eq	Table RS-2:	Equations to calculate cancer risks.
cNC Eq	Table RS-3:	Equations to calculate chronic noncancer risks.
scNC Eq	Table RS-4:	Equations to calculate subchronic noncancer risks.
Exp	Table RS-5:	Definitions and exposure factors.
Produce	Table RS-6:	Equations to calculate produce ingestion rate.
Chem	Table RS-7:	Chemical-specific data.

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Resident - Soil: Table RS-1
Exposure Point Concentration (EPC)
Based on Resident Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 4-06

Vlookup Version v0808

ELCR (all chemicals) = 2E-09

Chronic HI (all chemicals) = 1E-02

Subchronic HI (all chemicals) = 3E-03

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	$ELCR_{ingestion}$	$ELCR_{dermal}$	$ELCR_{vegetable}$	$ELCR_{total}$	Chronic HQ_{ing}	Chronic HQ_{derm}	Chronic $HQ_{vegetable}$	Chronic HQ_{total}	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic $HQ_{vegetable}$	Subchronic HQ_{total}
Benzene	4.0E-02	8.2E-10	6.8E-10		1.5E-09	2.4E-05	1.6E-05		4.1E-05	2.7E-05	1.2E-05		3.9E-05
Toluene	4.0E-02					1.2E-06	1.2E-06		2.4E-06	3.3E-07	2.3E-07		5.7E-07
Ethylbenzene	4.0E-02					9.7E-07	1.6E-06		2.6E-06	2.7E-07	3.1E-07		5.8E-07
Xylenes (mixed isomers)	8.1E-02					9.8E-07	1.0E-06		2.0E-06	2.7E-06	1.9E-06		4.6E-06
Naphthalene	4.0E-01					1.7E-05	4.1E-05		5.9E-05	4.8E-06	7.8E-06		1.3E-05
Aliphatics C5 to C8	1.6E+00					9.7E-05	8.2E-04		9.2E-04	2.7E-05	1.6E-04		1.8E-04
Aliphatics C9 to C12	1.6E+00					3.9E-05	1.6E-04		2.0E-04	1.1E-05	3.1E-05		4.2E-05
Aliphatics C9 to C18	8.3E+00					2.0E-04	8.6E-04		1.1E-03	5.5E-05	1.6E-04		2.2E-04
Aromatics C9 to C10	1.6E+00					1.3E-04	5.5E-04		6.8E-04	3.6E-05	1.0E-04		1.4E-04
Aliphatics C19 to C36	1.4E+01					1.7E-05	1.5E-05		3.2E-05	1.6E-05	9.3E-06		2.5E-05
Aromatics C11 to C22	9.6E+01					2.8E-03	6.6E-03		9.4E-03	7.7E-04	1.2E-03		2.0E-03

Resident - Soil: Table RS-2
Equations to Calculate Cancer Risk for Resident (Age 1-31 years)

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing(1\text{-}31)} * CSF$$

$$LADD_{ing\ (1\text{-}31)} = LADD_{ing\ (1\text{-}8)} + LADD_{ing\ (8\text{-}15)} + LADD_{ing\ (15\text{-}31)}$$

$$LADD_{ing\ (age\ group\ x)} = \frac{[OHM]_{soil} * IR_x * RAF_{c\text{-}ing} * EF_{ing} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm\ (1\text{-}31)} = LADD_{derm\ (1\text{-}8)} + LADD_{derm\ (8\text{-}15)} + LADD_{derm\ (15\text{-}31)}$$

$$LADD_{derm(age\ group\ x)} = \frac{[OHM]_{soil} * SA_x * RAF_{c\text{-}derm} * SAF_x * EF_{derm} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Homegrown Produce

$$ELCR_{produce} = LADD_{produce(1\text{-}31)} * CSF$$

$$LADD_{produce(1\text{-}31)} = LADD_{produce(1\text{-}8)} + LADD_{produce(8\text{-}15)} + LADD_{produce(15\text{-}31)}$$

$$LADD_{produce(age\ x)} = \frac{[OHM_{soil}] * PUF * PIR_x * RAF_{produce} * EF_{produce} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
$IR_{(1\text{-}8)}$	100	mg/day
$IR_{(8\text{-}15)}$	50	mg/day
$IR_{(15\text{-}31)}$	50	mg/day
$PIR_{(1\text{-}8)}$	12,099	mg/day
$PIR_{(8\text{-}15)}$	17,809	mg/day
$PIR_{(15\text{-}31)}$	24,420	mg/day
$RAF_{c\text{-}ing}$	OHM specific	dimensionless
$RAF_{c\text{-}derm}$	OHM specific	dimensionless
$RAF_{c\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.412	event/day
$EF_{produce}$	1.00	event/day
ED	1	day/event
$EP_{(1\text{-}8)}$	7	years
$EP_{(8\text{-}15)}$	7	years
$EP_{(15\text{-}31)}$	16	years
C	0.000001	kg/mg
$BW_{(1\text{-}8)}$	17.0	kg
$BW_{(8\text{-}16)}$	39.9	kg
$BW_{(16\text{-}31)}$	58.7	kg
$AP_{(lifetime)}$	70	years
$SA_{(1\text{-}8)}$	2431	cm^2 / day
$SA_{(8\text{-}15)}$	4427	cm^2 / day
$SA_{(15\text{-}31)}$	5653	cm^2 / day
$SAF_{(1\text{-}8)}$	0.35	mg/cm^2
$SAF_{(8\text{-}15)}$	0.14	mg/cm^2
$SAF_{(15\text{-}31)}$	0.13	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Resident - Soil: Table RS-3
Equations to Calculate Chronic Noncancer Risk for Resident Child (Age 1-8 years)

Vlookup Version v0808

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD}$$

$$ADD_{produce} = \frac{[OHM_{soil}] * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	100	mg/day
PIR	12,099	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$RAF_{nc\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.412	event/day
$EF_{produce}$	1.00	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
EP	7	years
$EP_{cyanide}$	1	day
C	0.000001	kg/mg
BW	17.0	kg
AP	7	year
$AP_{cyanide}$	1	day
SA	2431	cm^2 / day
SAF	0.35	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Resident - Soil: Table RS-4
Equations to Calculate Subchronic Noncancer Risk for Resident Child (Age 1-2 years)

Vlookup Version v0808

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD_{subchronic}}$$

$$ADD_{produce} = \frac{[OHM_{soil}] * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	100	mg/day
PIR	10,900	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$RAF_{nc\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.714	event/day
$EF_{produce}$	1.00	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
$EP_{cyanide}$	1	day
EP	0.577	years
C	0.000001	kg/mg
BW	10.7	kg
AP	0.577	year
$AP_{cyanide}$	1	day
SA	1670	cm^2 / day
SAF	0.35	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Resident - Soil: Table RS-5
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
LADE - Lifetime Average Daily Exposure	chemical specific	$\mu g/m^3$	
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
ADE - Average Daily Exposure	chemical specific	mg/m^3	
EPC - Exposure Point Concentration	chemical specific	mg/kg	
PUF - Plant Uptake Factor	chemical specific	$(mg/mg)(mg/mg)^{-1}$	See Table RS-7; $(mg_{OHM}/mg_{plant})/(mg_{OHM}/mg_{soil})^{-1}$
$IR_{(1-2)}$ - Soil Ingestion Rate for age group 1-2	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
$IR_{(1-8)}$ - Soil Ingestion Rate for age group 1-8	100	mg/day	Ibid
$IR_{(8-15)}$ - Soil Ingestion Rate for age group 8-15	50	mg/day	Ibid
$IR_{(15-31)}$ - Soil Ingestion Rate for age group 15-31	50	mg/day	Ibid
$PIR_{(1-2)}$ = Produce Ingestion Rate for age group 1-2	10,900	mg/day	see Table RS-6
$PIR_{(1-8)}$ = Produce Ingestion Rate for age group 1-8	12,099	mg/day	see Table RS-6
$PIR_{(8-15)}$ = Produce Ingestion Rate for age group 8-15	17,809	mg/day	Ibid
$PIR_{(15-31)}$ = Produce Ingestion Rate for age group 15-31	24,420	mg/day	Ibid
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
$EF_{subchronic}$ - Exposure Frequency for subchronic ingestion or dermal exposure	0.714	event/day	5 days/week
$EF_{chronic}$ - Exposure Frequency for chronic ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
EF_{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
$EF_{produce}$ - Exposure Frequency for produce ingestion, cancer and noncancer	1.00	event/day	
$EF_{cyanide}$ - Exposure Frequency for subchronic and chronic non-cancer cyanide	1.00	event/day	
ED - Exposure Duration	1	day/event	
$EP_{(1-2)}$ - Exposure Period for age group 1-2	0.577	years	30 weeks
$EP_{(1-8)}$ - Exposure Period for age group 1-8	7	years	
$EP_{(8-15)}$ - Exposure Period for age group 8-15	7	years	
$EP_{(15-31)}$ - Exposure Period for age group 15-31	16	years	
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$BW_{(1-2)}$ - Body Weight for age group 1-2	10.7	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, females.
$BW_{(1-8)}$ - Body Weight for age group 1-8	17.0	kg	Ibid
$BW_{(8-15)}$ - Body Weight for age group 8-15	39.9	kg	Ibid
$BW_{(15-31)}$ - Body Weight for age group 15-31	58.7	kg	Ibid
$AP_{subchronic}$ - Averaging Period for subchronic noncancer	0.577	years	30 weeks
$AP_{chronic}$ - Averaging Period for chronic noncancer	7	years	
AP_{cancer} - Averaging Period for lifetime	70	years	
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$SA_{(1-2)}$ - Surface Area for age group 1-2	1670	cm^2 / day	50th percentile of face (1/3 head), forearms, hands, lower legs, and feet for females MADEP. 1995. Guidance for Disposal Site Risk Characterization. Appendix Table B-2.
$SA_{(1-8)}$ - Surface Area for age group 1-8	2431	cm^2 / day	Ibid
$SA_{(8-15)}$ - Surface Area for age group 8-15	4427	cm^2 / day	Ibid
$SA_{(15-31)}$ - Surface Area for age group 15-31	5653	cm^2 / day	Ibid
$SAF_{(1-2)}$ - Surface Adherence Factor for age group 1-2	0.35	mg/cm^2	All SAFs developed for ShortForm according to procedure outlined in MA DEP Technical Update:
$SAF_{(1-8)}$ - Surface Adherence Factor for age group 1-8	0.35	mg/cm^2	Weighted Skin-Soil Adherence Factors, April 2002
$SAF_{(8-15)}$ - Surface Adherence Factor for age group 8-15	0.14	mg/cm^2	
$SAF_{(15-31)}$ - Surface Adherence Factor for age group 15-31	0.13	mg/cm^2	

Resident - Soil: Table RS-6
Homegrown Produce Ingestion Rate

Vlookup Version v0808

Data on mean produce ingestion rates (wet weight, ww) in the Northeast was obtained from the 1994-1996 Continuing Survey of Food Intakes by Individuals (USDA). Data for both genders were used for children under 6, while data for males was used for individuals 6 and older. The mean ingestion rates presented in the survey represent the arithmetic average of all individuals surveyed, regardless of whether or not they had consumed the produce item (e.g., an individual that did not consume the produce item was assigned a rate of 0 g/day). To determine the mean ingestion rate for individuals who ate each produce item, the ingestion rate for all individuals (consumers and nonconsumers) was divided by the percentage of individuals who ate the item (Table RS-6A). These mean ingestion rates for the produce consumers were summed to determine the total produce ingestion rate for each age-group and converted to dry weight assuming the produce items were all 90% water.

To convert mean ingestion rates for the age-groups studied in the survey to age-groups used in risk calculations, each age-group ingestion rate from the survey (i.e., 1 - 2 year olds, 3 - 5 year olds, 6 - 11 year olds, 12 - 19 year olds, and 20 - 39 year olds) was weighted according to the number of years spent in the risk calculation age group (i.e., 1 - 8 year olds, 8 - 15 year olds, and 15 - 31 year olds) (Table RS-6B). It was assumed that 25% of produce ingested was home-grown (Table RS-6C).

Table RS-6A

	White Potatoes			Dark-green vegetables			Deep-yellow vegetables		
Age-groups studied in survey	Ingestion Rate for All g/d (ww)	% of individuals that consumed item.	Ingestion Rate for Consumers g/d (ww)	Ingestion Rate for All g/d (ww)	% of individuals that consumed item.	Ingestion Rate for Consumers g/d (ww)	Ingestion Rate for All g/d (ww)	% of individuals that consumed item.	Ingestion Rate for Consumers g/d (ww)
1-2	28	40.3	69.5	6	10.1	59.4	5	12.7	39.4
3-5	30	37.1	80.9	5	6.5	76.9	7	12.7	55.1
6-11	47	44.2	106.3	6	9.1	65.9	2	8.5	23.5
12-19	59	40.3	146.4	2	2.3	87.0	11	15.8	69.6
20-39	76	45.1	168.5	25	14.7	170.1	4	5.7	70.2

	Tomatoes			Lettuce			Green Beans		
Age-groups studied in survey	Ingestion Rate for All g/d (ww)	% of individuals that consumed item.	Ingestion Rate for Consumers g/d (ww)	Ingestion Rate for All g/d (ww)	% of individuals that consumed item.	Ingestion Rate for Consumers g/d (ww)	Ingestion Rate for All g/d (ww)	% of individuals that consumed item.	Ingestion Rate for Consumers g/d (ww)
1-2	10	27.9	35.8	1	6	16.7	7	12.1	57.9
3-5	10	37.1	27.0	4	14	28.6	3	5.7	52.6
6-11	20	42	47.6	8	14.9	53.7	1	2	50.0
12-19	29	45.2	64.2	19	28.7	66.2	2	2.4	83.3
20-39	48	50.9	94.3	18	29.6	60.8	4	3.7	108.1

Table RS-6A (continued)

	Corn, Green peas, Lima beans		Melons, berries		Totals	Totals
	Ingestion	Ingestion	Ingestion	Ingestion	Wet Weight	Dry Weight

Age-groups studied in survey	Rate for All g/d (ww)	% of individuals that consumed item.	Rate for Consumers g/d (ww)	Rate for All g/d (ww)	% of individuals that consumed item.	Rate for Consumers g/d (ww)	WWI g/day	DWI g/day
1-2	12	15	80.0	7	9	77.8	436.4	43.6
3-5	14	21.7	64.5	14	11.6	120.7	506.3	50.6
6-11	9	13.6	66.2	5	5.9	84.7	498.0	49.8
12-19	14	9.9	141.4	17	5	340.0	998.1	99.8
20-39	12	7.3	164.4	6	4.5	133.3	969.7	97.0

Table RS-6B

Age-groups studied in survey	Years spent in age-group for 1-8 year old	Years spent in age-group for 8-15 year old	Years spent in age-group for 15-31 year old
1-2	2		
3-5	3		
6-11	2	4	
12-19		3	4
20-39			12
	7	7	16

Table RS-6C

	Produce Intake, dry weight			
	Child 1-2 years g/day	Child 1-8 years g/day	Child 8-15 years g/day	Adult 15-31 g/day
All Produce:	43.6	48.4	71.2	97.7
Homegrown:	10.9	12.1	17.8	24.4

Resident - Soil: Table RS-7
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	CSF (mg/kg-day)[1]	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	$RAF_{c\text{-}prod}$	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic $RAF_{nc\text{-}ing}$	Chronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$	$RAF_{nc\text{-}prod}$	PUF
Benzene	5.5E-02	1.00	0.08		4.0E-03	1.0E-02	1	0.08	1	0.08		
Toluene					8.0E-02	8.0E-01	1	0.12	1	0.12		
Ethylbenzene					1.0E-01	1.0E+00	1	0.2	1	0.2		
Xylenes (mixed isomers)					2.0E-01	2.0E-01	1	0.12	1	0.12		
Naphthalene					2.0E-02	2.0E-01	0.36	0.1	0.36	0.1		
Aliphatics C5 to C8					4.0E-02	4.0E-01	1	1	1	1		
Aliphatics C9 to C12					1.0E-01	1.0E+00	1	0.5	1	0.5		
Aliphatics C9 to C18					1.0E-01	1.0E+00	1	0.5	1	0.5		
Aromatics C9 to C10					3.0E-02	3.0E-01	1	0.5	1	0.5		
Aliphatics C19 to C36					2.0E+00	6.0E+00	1	0.1	1	0.1		
Aromatics C11 to C22					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		

Method 3 Risk Assessment for Chemicals in Soil - Construction Worker Shortform 2008 (sf08cw)

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Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk
Based on Construction Worker 18-25 years of age

ShortForm Version 08-08

Vlookup Version v0808

ELCR (all chemicals) = 4E-11

HI (all chemicals) = 7E-04

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Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material (OHM)	EPC (mg/kg)	ELCR ingestion	ELCR dermal	ELCR inhalation GI	ELCR inhalation pulmonary	$ELCR_{total}$	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic HQ_{inh-GI}	Subchronic HQ_{inh}	HQ_{total}
Benzene	4.0E-02	1.9E-11	1.6E-11	5.0E-13	8.3E-14	3.5E-11	4.9E-06	4.0E-06	1.3E-07	1.7E-08	9.0E-06
Toluene	4.0E-02						6.2E-08	7.4E-08	1.6E-09	3.0E-10	1.4E-07
Ethylbenzene	4.0E-02						4.9E-08	9.9E-08	1.3E-09	1.5E-09	1.5E-07
Xylenes (mixed isomers)	8.1E-02						5.0E-07	6.0E-07	1.3E-08	1.0E-08	1.1E-06
Naphthalene	4.0E-01						8.9E-07	2.5E-06	2.3E-08	5.0E-06	8.4E-06
Aliphatics C5 to C8	1.6E+00						4.9E-06	5.0E-05	1.3E-07	3.0E-07	5.5E-05
Aliphatics C9 to C12	1.6E+00						2.0E-06	9.9E-06	5.1E-08	9.9E-08	1.2E-05
Aliphatics C9 to C18	8.3E+00						1.0E-05	5.1E-05	2.6E-07	5.2E-07	6.2E-05
Aromatics C9 to C10	1.6E+00						6.6E-06	3.3E-05	1.7E-07	1.2E-07	4.0E-05
Aliphatics C19 to C36	1.4E+01						2.9E-06	3.0E-06	7.6E-08		6.0E-06
Aromatics C11 to C22	9.6E+01						1.4E-04	4.0E-04	3.7E-06	7.1E-06	5.5E-04

Construction Worker - Soil: Table CW-2
Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c\text{-}ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c\text{-}derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh\text{-}GI} = LADD_{inh\text{-}GI} * CSF_{oral}$$

$$LADD_{inh\text{-}GI} = \frac{EPC * RCAF_{inh\text{-}gi} * PM_{10} * VR_{work} * RAF_{c\text{-}ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c\text{-}inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
$RAF_{c\text{-}ing}$	OHM-specific	dimensionless
$RAF_{c\text{-}derm}$	OHM-specific	dimensionless
$RAF_{c\text{-}inh}$	OHM-specific	dimensionless
EF	0.714	event/day
$ED_{ing\ \&\ derm}$	1	day/event
ED_{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m^3/L
BW	58.0	kg
$AP_{(lifetime)}$	25,550	days
VR_{work}	60	L/min
AF	0.29	mg/cm^2
SA	3473	cm^2/day
$RCAF_{inh\text{-}gi}$	1.5	dimensionless
$RCAF_{inh}$	0.5	dimensionless
PM_{10}	60	$\mu g/m^3$

Construction Worker - Soil: Table CW-3
Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0808

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc\text{-}ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{dermal} = \frac{EPC * SA * AF * RAF_{nc\text{-}derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh\text{-}GI} = \frac{ADD_{inh\text{-}GI}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{inh\text{-}GI} = \frac{EPC * RCAF_{inh\text{-}gi} * PM_{10} * VR_{work} * RAF_{nc\text{-}ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation\text{-}subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc\text{-}inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
$RAF_{nc\text{-}ing}$	OHM-specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM-specific	dimensionless
$RAF_{nc\text{-}inh}$	OHM-specific	dimensionless
EF	0.714	event/day
$EF_{cyanide}$	1	event/day
$ED_{ing\ \&\ derm}$	1	day/event
ED_{inh}	0.333	day/event
EP	182	days
$EP_{cyanide}$	1.00	day
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m^3/L
BW	58.0	kg
$AP_{noncancer}$	182	days
$AP_{cyanide}$	1	day
VR_{work}	60	L/min
AF	0.29	mg/cm^2
SA	3473	cm^2/day
$RCAF_{inh\text{-}gi}$	1.5	dimensionless
$RCAF_{inh}$	0.5	dimensionless
PM10	60	$\mu g/m^3$

Cyanide can cause a significant health risk from a one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Construction Worker - Soil: Table CW-4
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	µg/L	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF_{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
$EF_{cyanide}$ - Exposure Frequency for Cyanide Exposures	1.00	event/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$ED_{ing,derm}$ - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED_{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
$AP_{(lifetime)}$ - Averaging Period for lifetime	25,550	days	Represents 70 years
$AP_{(noncancer)}$ - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
AF - Adherence Factor	0.29	mg/cm^2	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR_{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm^2/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
$RCAF_{inh\text{-}gi}$ - Relative Concentration Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
$RCAF_{inh}$ - Relative Concentration Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM_{10}	60	$\mu g/m^3$	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	Oral CSF $(mg/kg\text{-}day)^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	$RAF_{c\text{-}inh}$	Inhalation CSF $(mg/kg\text{-}day)^{-1}$	Subchronic Oral RfD mg/kg-day	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}inh}$	Subchronic Inhalation RfD
Benzene	5.5E-02	1	0.08	1	2.7E-02	1.0E-02	1	0.08	1	2.6E-02
Toluene						8.0E-01	1	0.12	1	1.4E+00
Ethylbenzene						1.0E+00	1	0.2	1	2.9E-01
Xylenes (mixed isomers)						2.0E-01	1	0.12	1	8.6E-02
Naphthalene						2.0E-01	0.36	0.1	1	8.6E-04
Aliphatics C5 to C8						4.0E-01	1	1	1	5.7E-02
Aliphatics C9 to C12						1.0E+00	1	0.5	1	1.7E-01
Aliphatics C9 to C18						1.0E+00	1	0.5	1	1.7E-01
Aromatics C9 to C10						3.0E-01	1	0.5	1	1.4E-01
Aliphatics C19 to C36						6.0E+00	1	0.1		
Aromatics C11 to C22						3.0E-01	0.36	0.1	1	1.4E-01

Method 3 Risk Assessment for a Trespasser Exposed to Chemicals in Soil - Shortform 2006 (sf06ts)

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scNC Eq	Table TS-4:	Equations to calculate subchronic noncancer risks.
Exp	Table TS-5:	Definitions and exposure factors.
Chem	Table TS-6:	Chemical-specific data.

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Trespasser - Soil: Table TS-1
Exposure Point Concentration (EPC)
Based on Trespasser Ages 11-18 (Cancer and Non-Cancer)

ShortForm Version 6-06

Vlookup Version v0808

ELCR (all chemicals) = 6E-11

Chronic HI (all chemicals) = 8E-04

Subchronic HI (all chemicals) = 2E-04

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Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	$ELCR_{ingestion}$	$ELCR_{dermal}$	$ELCR_{total}$	Chronic HQ_{ing}	Chronic HQ_{derm}	Chronic HQ_{total}	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic HQ_{total}
Benzene	4.0E-02	3.6E-11	2.3E-11	5.9E-11	1.6E-06	1.1E-06	2.7E-06	1.4E-06	7.9E-07	2.2E-06
Toluene	4.0E-02				8.1E-08	8.0E-08	1.6E-07	1.8E-08	1.5E-08	3.2E-08
Ethylbenzene	4.0E-02				6.5E-08	1.1E-07	1.7E-07	1.4E-08	2.0E-08	3.4E-08
Xylenes (mixed isomers)	8.1E-02				6.6E-08	6.5E-08	1.3E-07	1.4E-07	1.2E-07	2.6E-07
Naphthalene	4.0E-01				1.2E-06	2.7E-06	3.8E-06	2.6E-07	4.9E-07	7.5E-07
Aliphatics C5 to C8	1.6E+00				6.5E-06	5.3E-05	6.0E-05	1.4E-06	9.8E-06	1.1E-05
Aliphatics C9 to C12	1.6E+00				2.6E-06	1.1E-05	1.3E-05	5.7E-07	2.0E-06	2.5E-06
Aliphatics C9 to C18	8.3E+00				1.3E-05	5.5E-05	6.9E-05	2.9E-06	1.0E-05	1.3E-05
Aromatics C9 to C10	1.6E+00				8.6E-06	3.6E-05	4.4E-05	1.9E-06	6.6E-06	8.4E-06
Aliphatics C19 to C36	1.4E+01				1.2E-06	9.5E-07	2.1E-06	8.4E-07	5.9E-07	1.4E-06
Aromatics C11 to C22	9.6E+01				1.9E-04	4.3E-04	6.1E-04	4.1E-05	7.8E-05	1.2E-04

Trespasser - Soil: Table TS-2
Equations to Calculate Cancer Risk for a Trespasser (Age 11-18 years)

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF$$

$$LADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{c\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{c\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{c\text{-}ing}$	OHM specific	dimensionless
$RAF_{c\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.164	event/day
ED	1	day/event
EP	7	years
C	0.000001	kg/mg
BW	50.7	kg
$AP_{(lifetime)}$	70	years
SA	2940	cm^2 / day
SAF	0.14	mg/cm^2

Trespasser - Soil: Table TS-3
Equations to Calculate Chronic Noncancer Risk for a Trespasser (Age 11-18 years)

Vlookup Version v0808

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.164	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
EP	7	years
$EP_{cyanide}$	1	day
C	0.000001	kg/mg
BW	50.7	kg
AP	7	year
$AP_{cyanide}$	1	day
SA	2940	cm^2 / day
SAF	0.14	mg/cm^2

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Trespasser - Soil: Table TS-4
Equations to Calculate Subchronic Noncancer Risk for a Trespasser (Age 11-12 years)

Vlookup Version v0808

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.286	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
$EP_{cyanide}$	1	day
EP	0.577	years
C	0.000001	kg/mg
BW	40.3	kg
AP	0.577	year
$AP_{cyanide}$	1	day
SA	2477	cm^2 / day
SAF	0.14	mg/cm^2

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Trespasser - Soil: Table TS-5
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
EPC - Exposure Point Concentration	chemical specific	mg/kg	
IR - Soil Ingestion Rate	50	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
$EF_{subchronic}$ - Exposure Frequency for subchronic ingestion or dermal exposure	0.286	event/day	2 days/week
$EF_{chronic}$ - Exposure Frequency for chronic ingestion or dermal exposure	0.164	event/day	2 days/week, 30 weeks/year
EF_{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.164	event/day	2 days/week, 30 weeks/year
$EF_{cyanide}$ - Exposure Frequency for cyanide exposure	1.00	event/day	
ED - Exposure Duration	1	day/event	
$EP_{(11\text{-}12)}$ - Exposure Period for age group 11-12	0.577	years	30 weeks
$EP_{(11\text{-}18)}$ - Exposure Period for age group 11-18	7	years	
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$BW_{(11\text{-}12)}$ - Body Weight for age group 11-12	40.3	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7
$BW_{(11\text{-}18)}$ - Body Weight for age group 11-18	50.7	kg	Ibid
$AP_{subchronic}$ - Averaging Period for subchronic noncancer	0.577	years	30 weeks
$AP_{chronic}$ - Averaging Period for chronic noncancer	7	years	
AP_{cancer} - Averaging Period for lifetime	70	years	
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$SA_{(11\text{-}12)}$ - Surface Area for age group 11-12	2477	cm^2 / day	50th percentile of forearms, hands, and feet for females. MADEP 1995 Guidance for Disposal Site Risk Characterization, Table B-2.
$SA_{(11\text{-}18)}$ - Surface Area for age group 11-18	2940	cm^2 / day	Ibid
SAF - Surface Adherence Factor, Trespasser	0.14	mg/cm^2	SAF developed for ShortForm according to procedure outlined in MA DEP Technical Update: Weighted Skin-Soil Adherence Factors, April 2002.

Trespasser - Soil: Table TS-6
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	CSF $(mg/kg\text{-}day)^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic $RAF_{nc\text{-}ing}$	Chronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$
Benzene	5.5E-02	1.00	0.08	4.0E-03	1.0E-02	1	0.08	1	0.08
Toluene				8.0E-02	8.0E-01	1	0.12	1	0.12
Ethylbenzene				1.0E-01	1.0E+00	1	0.2	1	0.2
Xylenes (mixed isomers)				2.0E-01	2.0E-01	1	0.12	1	0.12
Naphthalene				2.0E-02	2.0E-01	0.36	0.1	0.36	0.1
Aliphatics C5 to C8				4.0E-02	4.0E-01	1	1	1	1
Aliphatics C9 to C12				1.0E-01	1.0E+00	1	0.5	1	0.5
Aliphatics C9 to C18				1.0E-01	1.0E+00	1	0.5	1	0.5
Aromatics C9 to C10				3.0E-02	3.0E-01	1	0.5	1	0.5
Aliphatics C19 to C36				2.0E+00	6.0E+00	1	0.1	1	0.1
Aromatics C11 to C22				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1

Vlookup Version v0808				SUBCHRONIC		Chronic		Subchronic						SUBCHRONIC			
OIL OR HAZARDOUS MATERIAL	CAS	CHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Inhalation Reference Concentration (or substitute) mg/m3	REF	Inhalation Reference Concentration (or substitute) mg/m3	REF	Oral Cancer Slope Factor $(mg/kg/day)^{-1}$	CLASS	REF	Inhalation Unit Risk $(\mu g/m3)^{-1}$	REF	INHALATION REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Inhalation Cancer Slope Factor $(mg/kg/day)^{-1}$	REF
Acenaphthene	83-32-9	6.0E-02	1	6.0E-01	2	5.0E-02	44	5.0E-01	44						1.4E-01	45		46
Acenaphthylene	208-98-8	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Acetone	67-64-1	9.0E-01	1	2.7E+00	1i	6.0E-01	3	6.0E-01	40		D	1			2.3E-01	45		46
Aldrin	309-00-2	3.0E-05	1	3.0E-05	2	1.1E-04		1.1E-04	40	1.7E+01	B2	1	4.90E-03	1	3.0E-05	45	1.7E+01	46
Anthracene	120-12-7	3.0E-01	1	3.0E+00	2	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Antimony	7440-36-0	4.0E-04	1	4.0E-04	2	1.0E-02	3	1.0E-02	40						2.9E-03	45		46
Arsenic	7440-38-2	3.0E-04	1	3.0E-04	2	2.5E-06	3	2.5E-06	40	1.5E+00	A	1	4.30E-03	1	7.1E-07	45	1.5E+01	46
Barium	7440-39-3	2.0E-01	1	7.00E-02	2	5.0E-04	2e	5.0E-03	2b						1.4E-03	45		46
Benzene	71-43-2	4.0E-03	1	1.0E-02	1i	3.0E-02	1	9.0E-02	1k	5.5E-02	A	1	7.80E-06	1	2.6E-02	45	2.7E-02	46
Benzo(a)anthracene	56-55-3	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E-01	B2	1e	2.09E-04	35	1.4E-01	45	7.3E-01	46
Benzo(a)pyrene	50-32-8	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E+00	B2	1	2.09E-03	35	1.4E-01	45	7.3E+00	46
Benzo(b)fluoranthene	205-99-2	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E-01	B2	1e	2.09E-04	35	1.4E-01	45	7.3E-01	46
Benzo(g,h,i)perylene	191-24-2	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44						1.4E-01	45		46
Benzo(k)fluoranthene	207-08-9	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E-02	B2	1e	2.09E-05	35	1.4E-01	45	7.3E-02	46
Beryllium	7440-41-7	2.0E-03	1	5.0E-03	2	2.0E-05	1	2.0E-05	1j		B1	1f	2.40E-03	1	5.7E-06	45	8.4E+00	46
Biphenyl, 1,1-	92-52-4	5.0E-02	1	5.0E-02	2	2.0E-03	3	2.0E-03	40		D	1			5.7E-04	45		46
Bis(2-chloroethyl)ether	111-44-4									1.1E+00	B2	1	3.30E-04	1		45	1.2E+00	46
Bis(2-chloroisopropyl)ether	39638-32-9	4.0E-02	1	4.0E-02	1d	1.4E-01	39	1.4E-01	40	7.0E-02	C	2d	1.00E-05	2	4.0E-02	45	3.5E-02	46
Bis(2-ethylhexyl)phthalate	117-81-7	2.0E-02	1	2.0E-02	2d	7.0E-03	3	7.0E-03	40	1.4E-02	B2	1	1.30E-06	3	2.0E-03	45	4.6E-03	46
Bromodichloromethane	75-27-4	2.0E-02	1	2.0E-02	2	7.0E-02	39	7.0E-02	40	6.2E-02	B2	1	1.77E-05	35	2.0E-02	45	6.2E-02	46
Bromoform	75-25-2	2.0E-02	1	2.0E-01	2	7.0E-02	39	7.0E-01	1k	7.9E-03	B2	1	1.10E-06	1	2.0E-01	45	3.9E-03	46
Bromomethane	74-83-9	1.4E-03	1	1.4E-02	2d	5.0E-03	1	5.0E-02	1k		D	1			1.4E-02	45		46
Cadmium	7440-43-9	5.0E-04	1c	5.0E-04	1d	2.0E-05	3	2.0E-05	40		B1	1	1.80E-03	1	5.7E-06	45	6.3E+00	46
Carbon tetrachloride	56-23-5	7.0E-04	1	7.0E-03	2d	4.3E-01	3	4.3E-01	40	1.3E-01	B2	1	1.50E-05	1	1.2E-01	45	5.3E-02	46
Chlordane	12789-03-6	5.0E-04	1	5.0E-04	1d	7.0E-04	1	7.0E-03	1k	3.5E-01	B2	1	1.00E-04	1	2.0E-03	45	3.5E-01	46
Chloroaniline, p-	106-47-8	4.0E-03	1	4.0E-03	2	1.4E-02	39	1.4E-02	40						4.0E-03	45		46
Chlorobenzene	108-90-7	2.0E-02	1	2.0E-01	2d	2.0E-02	2e	2.0E-02	40		D	1			5.7E-03	45		46
Chloroform	67-66-3	1.0E-02	1	1.0E-02	2	6.6E-01	3	6.8E-01	40		B2	1	2.30E-05	1	1.9E-01	45	6.1E-02	46
Chlorophenol, 2-	95-57-8	5.0E-03	1	5.0E-02	2	1.8E-02	39	1.8E-01	1k						5.1E-02	45		46
Chromium (total)	7440-47-3	3.0E-03		2.0E-02		1.0E-04		3.0E-04					1.20E-02		6.6E-05	45	4.2E+01	46
Chromium(III)	16065-83-1	1.5E+00	1	1.5E+00	1d	1.0E-04	1h	3.0E-04	1k						8.6E-05	45		46
Chromium(VI)	18540-29-9	3.0E-03	1	2.0E-02	2	1.0E-04	1	3.0E-04	1k				1.20E-02	1	6.6E-05	45	4.2E+01	46
Chrysene	218-01-9	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E-02	B2	1e	2.09E-05	35	1.4E-01	45	7.3E-02	46
Cyanide	57-12-5	1.0E-02	4a	1.0E-02	4a	7.0E-03	4	7.0E-03	40		D	1			2.0E-03	45		46
Dibenz(a,h)anthracene	53-70-3	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E+00	B2	1e	2.09E-03	35	1.4E-01	45	7.3E+00	46
Dibromochloromethane	124-48-1	2.0E-02	1	2.0E-01	2	7.0E-02	39	7.0E-01	1k	8.4E-02	C	1	2.40E-05	35	2.0E-01	45	8.4E-02	46
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	9.0E-02	1	9.0E-01	2d	2.0E-01	2e	2.0E-01	40		D	1			5.7E-02	45		46
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	9.0E-02	1b	9.0E-01	2a	2.0E-01	2f	2.0E-01	40		D	1			5.7E-02	45		46
Dichlorobenzene, 1,4- (p-DCB)	106-48-7	9.0E-02	1b	9.0E-01	2a	6.0E-01	1	2.4E+00	1k	2.4E-02	C	2	6.86E-06	35	8.9E-01	45	2.4E-02	46
Dichlorobenzidine, 3,3'-	91-94-1									4.5E-01	B2	1	1.29E-04	35		45	4.5E-01	46
DDD	72-54-8	5.0E-04	1g	5.0E-04	2g	1.8E-03	39	1.8E-03	40	2.4E-01	B2	1	6.86E-05	35	5.0E-04	45	2.4E-01	46
DDE	72-55-9	5.0E-04	1g	5.0E-04	2g	1.8E-03	39	1.8E-03	40	3.4E-01	B2	1	9.71E-05	35	5.0E-04	45	3.4E-01	46
DDT	50-29-3	5.0E-04	1	5.0E-04	2	1.8E-03	39	1.8E-03	40	3.4E-01	B2	1	9.70E-05	1	5.0E-04	45	3.4E-01	46
Dichloroethane, 1,1-	75-34-3	1.0E-01	2	1.0E+00	2	5.0E-01	2e	5.0E+00	2b		C	1		35	1.4E+00	45		46
Dichloroethane, 1,2-	107-06-2	2.0E-02	4	2.0E-01	4	5.5E-02	3	5.5E-02	40	9.1E-02	B2	1	2.80E-05	1	1.6E-02	45	9.1E-02	46
Dichloroethylene, 1,1-	75-35-4	5.0E-02	1	5.0E-02	1d	2.0E-01	1	2.0E-01	1j		C	1		1	5.7E-02	45		46
Dichloroethylene, cis-1,2-	156-59-2	1.0E-02	2	1.0E-01	2	3.5E-02	39	3.5E-02	40		D	1			1.0E-02	45		46
Dichloroethylene, trans-1,2-	156-60-5	2.0E-02	1	2.0E-01	2	7.0E-02	39	7.0E-01	1k						2.0E-01	45		46
Dichloromethane	75-09-2	6.0E-02	1	6.0E-02	2	3.0E+00	2	3.0E+00	40	7.5E-03	B2	1	4.70E-07	1	6.8E-01	45	1.6E-03	46
Dichlorophenol, 2,4-	120-83-2	3.0E-03	1	3.0E-03	2	1.1E-02	39	1.1E-02	40						3.0E-03	45		46
Dichloropropane, 1,2-	78-87-5					4.0E-03	1	1.2E-02	1k	6.8E-02	B2	2	1.90E-05	3	3.4E-03	45	6.7E-02	46
Dichloropropene, 1,3-	542-75-6	3.0E-02	1	3.0E-02	1d	2.0E-02	1	2.0E-02	1j	1.0E-01	B2	1	4.00E-06	1	5.7E-03	45	1.4E-02	46
Dieldrin	60-57-1	5.0E-05	1	5.0E-05	2	1.6E-04	39	1.8E-04	40	1.6E+01	B2	1	4.60E-03	1	5.0E-05	45	1.6E+01	46
Diethyl phthalate	84-66-2	6.0E-01	1	6.0E+00	2	2.8E+00	39	2.8E+01	1k		D	1			6.0E+00	45		46
Dimethyl phthalate	131-11-3	1.0E+01	2d	1.0E+01	2d	3.5E+01	39	3.5E+01	40		D	1			1.0E+01	45		46
Dimethylphenol, 2,4-	105-87-9	2.0E-02	1	2.0E-01	2	7.0E-02	39	7.0E-01	1k						2.0E-01	45		46
Dinitrophenol, 2,4-	51-28-5	2.0E-03	1	2.0E-03	2	7.0E-03	39	7.0E-02	1k						2.0E-02	45		46
Dinitrotoluene, 2,4-	121-14-2	2.0E-03	1	2.0E-03	2	7.0E-03	39	7.0E-03	40	6.8E-01	B2	1a	1.94E-04	35	2.0E-03	45	6.8E-01	46
Dioxane, 1,4-	123-91-1	1.0E-02	5	1.0E-01	5	1.2E-01	2	1.2E-01	40	1.1E-02	B2	1	4.10E-06	3	3.4E-02	45	1.4E-02	46
Endosulfan	115-29-7	6.0E-03	1	6.0E-03	2	2.1E-02	39	2.1E-02	40						6.0E-03	45		46
Endrin	72-20-8	3.0E-04	1	3.0E-04	2	1.1E-03	39	1.1E-03	40		D	1			3.0E-04	45		46
Ethylbenzene	100-41-4	1.0E-01	1	1.0E+00	2d	1.0E+00	1	1.0E+00	1j		D	1			2.9E-01	45		46
Ethylene dibromide	106-93-4	9.0E-03	1	9.0E-03	1d	9.0E-03	1	9.0E-03	40	2.0E+00	B2	1	3.00E-04	1	2.6E-03	45	1.1E+00	46
Fluoranthene	206-44-0	4.0E-02	1	4.0E-01	2	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Fluorene	86-73-7	4.0E-02	1	4.0E-01	2	5.0E-02	44	5.0E-01	44						1.4E-01	45		46

Vlookup Version v0806 OIL OR HAZARDOUS MATERIAL	CAS	CHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	SUBCHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Chronic Inhalation Reference Concentration (or substitute) mg/m3	REF	Subchronic Inhalation Reference Concentration (or substitute) mg/m3	REF	Oral Cancer Slope Factor $(mg/kg/day)^{-1}$	CLASS	REF	Inhalation Unit Risk $(\mu g/m3)^{-3}$	REF	SUBCHRONIC INHALATION REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Inhalation Cancer Slope Factor $(mg/kg/day)^{-1}$	REF
Heptachlor	76-44-8	5.0E-04	1	5.0E-04	2	1.0E-03	3	1.0E-03	40	4.5E+00	B2	1	1.30E-03	1	2.9E-04	45	4.6E+00	46
Heptachlor epoxide	1024-57-3	1.3E-05	1	1.3E-05	2	4.6E-05	39	4.6E-05	40	9.1E+00	B2	1	2.80E-03	1	1.3E-05	45	9.1E+00	46
Hexachlorobenzene	118-74-1	8.0E-04	1	8.0E-04	2d	2.6E-03	39	2.6E-03	40	1.6E+00	B2	1	4.80E-04	1	6.0E-04	45	1.6E+00	46
Hexachlorobutadiene	87-68-3	2.0E-04	2	2.0E-03	2d	7.0E-04	39	7.0E-04	40	7.8E-02	C	1	2.20E-05	1	2.0E-04	45	7.7E-02	46
gamma-HCH	58-89-9	3.0E-04	1	3.0E-03	2	1.1E-03	39	1.1E-02	1k	1.3E+00	B2-C	2	3.71E-04	35	3.1E-03	45	1.3E+00	46
Hexachloroethane	67-72-1	1.0E-03	1	1.0E-02	2	3.0E-03	3	3.0E-03	40	1.4E-02	C	1	4.00E-06	1	8.6E-04	45	1.4E-02	46
Hmx	2691-41-0	5.0E-02	1	5.0E-02	1d	1.8E-01	39	1.8E-01	40		D	1			5.0E-02	45		46
Indeno(1,2,3-cd)pyrene	193-39-5	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E-01	B2	1e	2.09E-04	35	1.4E-01	45	7.3E-01	46
Lead	7439-92-1	7.5E-04	4	7.5E-04	4	1.0E-03	3	1.0E-03	40		B2	1			2.9E-04	45		46
Mercury	7439-97-6	3.0E-04	2d	3.0E-04	2d	3.0E-04	1	3.0E-04	1j		D	1			8.6E-05	45		46
Methoxychlor	72-43-5	5.0E-03	1	5.0E-03	2	1.8E-02	39	1.8E-02	40		D	1			5.0E-03	45		46
Methyl ethyl ketone	78-93-3	6.0E-01	1	6.0E-01	1d	5.0E+00	1	5.0E+00	1j		D	1			1.4E+00	45		46
Methyl isobutyl ketone	108-10-1	8.0E-02	2	6.0E-01	2	3.0E+00	2l	3.0E+00	40						6.6E-01	45		46
Methyl mercury	22967-92-6	1.0E-04	1	1.0E-04	2	2.0E-05	3	2.0E-05	40		C	1			5.7E-06	45		46
Methyl tert butyl ether	1634-04-4	1.0E-01	5	1.0E+00	5	3.0E+00	1	3.0E+00	40		C				8.6E-01	45		46
Methylnaphthalene, 2-	91-57-6	4.0E-03	1	4.0E-03	1j	5.0E-02	44	5.0E-01	44						1.4E-01	45		46
Naphthalene	91-20-3	2.0E-02	1	2.0E-01	1i	3.0E-03	1	3.0E-03	40						6.6E-04	45		46
Nickel	7440-02-0	2.0E-02	1	2.0E-02	2	1.0E-03	3	1.0E-03	40		A	1	4.80E-04	1	2.9E-04	45	1.7E+00	46
N-nitrosodimethylamine (NDMA)	62-75-9									5.1E+01	B2	1	1.40E-02	1		45	4.9E+01	46
Pentachlorophenol	87-86-5	3.0E-02	1	3.0E-02	2	7.0E-05	3	7.0E-05	40	1.2E-01	B2	1	3.43E-05	35	2.0E-05	45	1.2E-01	46
Perchlorate	NA	3.0E-05	41	9.0E-05	41	1.1E-04	39	1.1E-04	40						3.0E-05	45		46
Petroleum hydrocarbons	NA															45		46
Aliphatics C5 to C8	NA	4.0E-02	31a	4.0E-01	31	2.0E-01	31	2.0E-01	40						5.7E-02	45		46
Aliphatics C9 to C12	NA	1.0E-01	31a	1.0E+00	31	2.0E-01	31	6.0E-01	40						1.7E-01	45		46
Aliphatics C9 to C18	NA	1.0E-01	31a	1.0E+00	31	2.0E-01	31	6.0E-01	40						1.7E-01	45		46
Aliphatics C19 to C36	NA	2.0E+00	31a	6.0E+00	31		31									45		46
Aromatics C9 to C10	NA	3.0E-02	31a	3.0E-01	31	5.0E-02	31	5.0E-01	40						1.4E-01	45		46
Aromatics C11 to C22	NA	3.0E-02	31a	3.0E-01	31	5.0E-02	31	5.0E-01	40						1.4E-01	45		46
Phenanthrene	85-01-8	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Phenol	108-95-2	3.0E-01	1	3.0E-01	1d	2.6E-01	3	2.6E-01	40		D	1			7.4E-02	45		46
Polychlorinated biphenyls (PCBs)	1336-36-3	2.0E-05	1	5.0E-05	2	2.0E-05	3	2.0E-05	40	2.0E+00	B2	1	1.00E-04	1	5.7E-06	45	3.5E-01	46
Pyrene	129-00-0	3.0E-02	1	3.0E-01	2	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Rdx	121-82-4	3.0E-03	1	3.0E-03	1i	1.1E-02	39	1.1E-02	40	1.1E-01	C	1	3.14E-05	35	3.0E-03	45	1.1E-01	46
Selenium	7782-49-2	5.0E-03	1	5.0E-03	2	3.0E-03	3	3.0E-03	40		D	1			6.6E-04	45		46
Silver	7440-22-4	5.0E-03	1	5.0E-03	2	1.4E-04	5	1.4E-04	40		D	1			4.0E-05	45		46
Styrene	100-42-5	2.0E-01	1	2.0E+00	2d	1.0E+00	1	3.0E+00	1k	3.0E-02	B2	2d	5.70E-07	2d	6.6E-01	45	2.0E-03	46
TCDD, 2,3,7,8- (equivalents)	1746-01-6									1.5E+05	B2	2	3.30E+01	2		45	1.2E+05	46
Tetrachloroethane, 1,1,1,2-	630-20-6	3.0E-02	1	3.0E-02	2	1.1E-01	39	1.1E-01	40	2.6E-02	C	1	7.40E-06	1	3.0E-02	45	2.6E-02	46
Tetrachloroethane, 1,1,2,2-	79-34-5					9.3E-02	3	9.3E-02	40	2.0E-01	C	1	5.80E-05	1	2.7E-02	45	2.0E-01	46
Tetrachloroethylene	127-18-4	1.0E-02	1	1.0E-01	2	4.6E+00	3	4.6E+00	40	5.1E-02	C-B2	2c	1.00E-05	5	1.3E+00	45	3.5E-02	46
Thallium	7440-28-0	6.0E-05	1	6.0E-04	1i	1.4E-05	5	1.4E-05	40						4.0E-06	45		46
Toluene	108-88-3	8.0E-02	1	6.0E-01	1l	5.0E+00	1	5.0E+00	40		D	1			1.4E+00	45		46
Trichlorobenzene, 1,2,4-	120-82-1	1.0E-02	1	1.0E-02	2	2.0E-01	2	2.0E+00	2b		D	1			5.7E-01	45		46
Trichloroethane, 1,1,1-	71-55-6	9.0E-02	2d	9.0E-01	2d	5.2E+00	3	5.2E+00	40		D	1			1.5E+00	45		46
Trichloroethane, 1,1,2-	79-00-5	4.0E-03	1	4.0E-02	2	7.4E-02	3	7.4E-02	40	5.7E-02	C	1	1.60E-05	1	2.1E-02	45	5.6E-02	46
Trichloroethylene	79-01-6	2.0E-03	4	2.0E-02	4	1.8E-01	3	1.8E-01	40	1.1E-02	C-B2	2c	1.70E-06	2d	5.1E-02	45	6.0E-03	46
Trichlorophenol, 2,4,5-	95-95-4	1.0E-01	1	1.0E+00	2	3.5E-01	39	3.5E+00	1k						1.0E+00	45		46
Trichlorophenol 2,4,6-	88-06-2									1.1E-02	B2	1	3.10E-06	1		45	1.1E-02	46
Vanadium	7440-62-2	9.0E-03	1	9.0E-03	1d	1.0E-03	3	1.0E-03	40						2.9E-04	45		46
Vinyl chloride	75-01-4	3.0E-03	1	3.0E-03	1d	1.0E-01	1	1.0E-01	40	1.4E+00	A	1	8.80E-06	1	2.9E-02	45	3.1E-02	46
Xylenes (mixed isomers)	1330-20-7	2.0E-01	1	2.0E-01	1d	1.0E-01	3	3.0E-01	1k		D	1			6.6E-02	45		46
Zinc	7440-66-6	3.0E-01	1	3.0E-01	2	1.4E-03	5	1.4E-03	40		D	1			4.0E-04	45		46

OIL OR HAZARDOUS MATERIAL	CAS	Relative Absorption Factors (RAFs)							
		Soil						Air[1]	
		Chronic Ingestion	Chronic Dermal	Subchronic Ingestion	Subchronic Dermal	Cancer Ingestion	Cancer Dermal	Subchronic Inhalation	Cancer Inhalation
Acenaphthene	83-32-9	0.36	0.1	0.36	0.1	NC	NC	1	
Acenaphthylene	208-96-8	0.36	0.1	0.36	0.1	NC	NC	1	
Acetone	67-64-1	1	0.1	1	0.1	NC	NC	1	
Aldrin	309-00-2	1	0.25	1	0.25	1	0.25	1	1
Anthracene	120-12-7	0.36	0.1	0.36	0.1	NC	NC	1	
Antimony	7440-36-0	1	0.1	1	0.1	NC	NC	1	
Arsenic	7440-38-2	1	0.03	1	0.03	1	0.03	1	1
Barium	7440-39-3	1	0.05	1	0.05	NC	NC	1	
Benzene	71-43-2	1	0.08	1	0.08	1	0.08	1	1
Benzo(a)anthracene	56-55-3	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(a)pyrene	50-32-8	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(b)fluoranthene	205-99-2	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(g,h,i)perylene	191-24-2	0.36	0.1	0.36	0.1	NC	NC	1	
Benzo(k)fluoranthene	207-08-9	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Beryllium	7440-41-7	1	0.03	1	0.03	1	0.03	1	1
Biphenyl, 1,1-	92-52-4	1	0.08	1	0.08	NC	NC	1	
Bis(2-chloroethyl)ether	111-44-4	NC	NC	NC	NC	1	1		1
Bis(2-chloroisopropyl)ether	39638-32-9	1	1	1	1	1	1	1	1
Bis(2-ethylhexyl)phthalate	117-81-7	1	0.02	1	0.02	1	0.02	1	1
Bromodichloromethane	75-27-4	1	0.1	1	0.1	1	0.1	1	1
Bromoform	75-25-2	1	0.11	1	0.11	1	0.1	1	1
Bromomethane	74-83-9	1	0.1	1	0.1	NC	NC	1	
Cadmium	7440-43-9	1	0.14	1	0.14	NC	NC	1	1
Carbon tetrachloride	56-23-5	1	0.1	1	0.1	1	0.1	1	1
Chlordane	12789-03-6	1	0.05	1	0.05	1	0.05	1	1
Chloroaniline, p-	106-47-8	1	0.1	1	0.1	NC	NC	1	
Chlorobenzene	108-90-7	1	0.1	1	0.1	NC	NC	1	
Chloroform	67-66-3	1	0.1	1	0.1			1	1
Chlorophenol, 2-	95-57-8	1	0.26	1	0.26	NC	NC	1	
Chromium (total)	7440-47-3	1	0.09	1	0.09	NC	NC	1	1
Chromium(III)	16065-83-1	1	0.04	1	0.04	NC	NC	1	
Chromium(VI)	18540-29-9	1	0.09	1	0.09	NC	NC	1	1
Chrysene	218-01-9	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Cyanide	57-12-5	1	0.3	1	0.3	NC	NC	1	
Dibenzo(a,h)anthracene	53-70-3	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Dibromochloromethane	124-48-1	1	0.1	1	0.1	1	0.1	1	1
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	1	0.1	1	0.1	NC	NC	1	
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	1	0.1	1	0.1	NC	NC	1	
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	1	0.1	1	0.1	1	0.1	1	1
Dichlorobenzidine, 3,3'-	91-94-1	NC	NC	NC	NC	1	0.54		1
DDD	72-54-8	1	0.2	1	0.2	1	0.2	1	1
DDE	72-55-9	1	0.2	1	0.2	1	0.2	1	1
DDT	50-29-3	1	0.2	1	0.2	1	0.2	1	1
Dichloroethane, 1,1-	75-34-3	1.3	0.13	1.3	0.13	NC	NC	1	

Dichloroethane, 1,2-	107-06-2	1	0.1	1	0.1	1	0.1	1	1
Dichloroethylene, 1,1-	75-35-4	1	0.1	1	0.1			1	
Dichloroethylene, cis-1,2-	156-59-2	1	0.1	1	0.1	NC	NC	1	
Dichloroethylene, trans-1,2-	156-60-5	1	0.1	1	0.1	NC	NC	1	
Dichloromethane	75-09-2	1	0.1	1	0.1	1	0.1	1	1
Dichlorophenol, 2,4-	120-83-2	1	0.4	1	0.4	NC	NC	1	
Dichloropropane, 1,2-	78-87-5	NC	NC	NC	NC	1	0.2	1	1
Dichloropropene, 1,3-	542-75-6	1	0.2	1	0.2	1	0.2	1	1
Dieldrin	60-57-1	1	0.25	1	0.25	1	0.25	1	1
Diethyl phthalate	84-66-2	1	0.07	1	0.07	NC	NC	1	
Dimethyl phthalate	131-11-3	1	0.07	1	0.07	NC	NC	1	
Dimethylphenol, 2,4-	105-67-9	1	0.26	1	0.26	NC	NC	1	
Dinitrophenol, 2,4-	51-28-5	1	0.26	1	0.26	NC	NC	1	
Dinitrotoluene, 2,4-	121-14-2	1	0.13	1	0.13	1	0.13	1	1
Dioxane, 1,4-	123-91-1	1	0.25	1	0.25	1	0.25	1	1
Endosulfan	115-29-7	1	0.2	1	0.2	NC	NC	1	
Endrin	72-20-8	1	0.25	1	0.25	NC	NC	1	
Ethylbenzene	100-41-4	1	0.2	1	0.2	NC	NC	1	
Ethylene dibromide	106-93-4	1	0.1	1	0.1	1	0.1	1	1
Fluoranthene	206-44-0	0.36	0.1	0.36	0.1	NC	NC	1	
Fluorene	86-73-7	0.36	0.1	0.36	0.1	NC	NC	1	
Heptachlor	76-44-8	1	0.2	1	0.2	1	0.2	1	1
Heptachlor epoxide	1024-57-3	1	0.2	1	0.2	1	0.2	1	1
Hexachlorobenzene	118-74-1	1	0.13	1	0.13	1	0.13	1	1
Hexachlorobutadiene	87-68-3	1	0.2	1	0.2	1	0.2	1	1
gamma-HCH	58-89-9	1	0.2	1	0.2	1	0.2	1	1
Hexachloroethane	67-72-1	1	1	1	1	1	1	1	1
Hmx	2691-41-0	1	0.2	1	0.2	NC	NC	1	
Indeno(1,2,3-cd)pyrene	193-39-5	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Lead	7439-92-1	0.5	0.006	0.5	0.006	NC	NC	1	
Mercury	7439-97-6	1	0.05	1	0.05	NC	NC	1	
Methoxychlor	72-43-5	1	0.2	1	0.2	NC	NC	1	
Methyl ethyl ketone	78-93-3	1	0.1	1	0.1	NC	NC	1	
Methyl isobutyl ketone	108-10-1	1	0.1	1	0.1	NC	NC	1	
Methyl mercury	22967-92-6	1	0.2	1	0.2	NC	NC	1	
Methyl tert butyl ether	1634-04-4	1	0.1	1	0.1	NC	NC	1	
Methylnaphthalene, 2-	91-57-6	0.36	0.1	0.36	0.1	NC	NC	1	
Naphthalene	91-20-3	0.36	0.1	0.36	0.1	NC	NC	1	
Nickel	7440-02-0	1	0.35	1	0.35	NC	NC	1	1
N-nitrosodimethylamine (NDMA)	62-75-9					1	0.2		1
Pentachlorophenol	87-86-5	1	0.11	1	0.11	1	0.11	1	1
Perchlorate	NA	1	0.2	1	0.2			1	
Petroleum hydrocarbons	NA								
Aliphatics C5 to C8	NA	1	1	1	1	NC	NC	1	
Aliphatics C9 to C12	NA	1	0.5	1	0.5	NC	NC	1	
Aliphatics C9 to C18	NA	1	0.5	1	0.5	NC	NC	1	
Aliphatics C19 to C36	NA	1	0.1	1	0.1	NC	NC		
Aromatics C9 to C10	NA	1	0.5	1	0.5	NC	NC	1	
Aromatics C11 to C22	NA	0.36	0.1	0.36	0.1	NC	NC	1	
Phenanthrene	85-01-8	0.36	0.1	0.36	0.1	NC	NC	1	

Phenol	108-95-2	1	0.26	1	0.26	NC	NC	1	
Polychlorinated biphenyls (PCBs)	1336-36-3	0.85	0.16	0.85	0.16	0.85	0.16	1	1
Pyrene	129-00-0	0.36	0.1	0.36	0.1	NC	NC	1	
Rdx	121-82-4	1	0.2	1	0.2	1	0.2	1	1
Selenium	7782-49-2	1	0.002	1	0.002	NC	NC	1	
Silver	7440-22-4	1	0.25	1	0.25	NC	NC	1	
Styrene	100-42-5	1	0.2	1	0.2	1	0.2	1	1
TCDD, 2,3,7,8- (equivalents)	1746-01-6	NC	NC	NC	NC	1	0.2		1
Tetrachloroethane, 1,1,1,2-	630-20-6	1	1.4	1	1.4	1	1.4	1	1
Tetrachloroethane, 1,1,2,2-	79-34-5	NC	NC	NC	NC	1	1.4	1	1
Tetrachloroethylene	127-18-4	1	0.1	1	0.1	1	0.1	1	1
Thallium	7440-28-0	1	0.01	1	0.01	NC	NC	1	
Toluene	108-88-3	1	0.12	1	0.12	NC	NC	1	
Trichlorobenzene, 1,2,4-	120-82-1	1	0.08	1	0.08	NC	NC	1	
Trichloroethane, 1,1,1-	71-55-6	1	0.1	1	0.1	NC	NC	1	
Trichloroethane, 1,1,2-	79-00-5	1	1	1	1	1	1	1	1
Trichloroethylene	79-01-6	1	0.1	1	0.1	1	0.1	1	1
Trichlorophenol, 2,4,5-	95-95-4	1	0.26	1	0.26	NC	NC	1	
Trichlorophenol 2,4,6-	88-06-2	NC	NC	NC	NC	1	0.26		1
Vanadium	7440-62-2	1	0.03	1	0.03	NC	NC	1	
Vinyl chloride	75-01-4	1	0.1	1	0.1	1.53	0.16	1	1
Xylenes (mixed isomers)	1330-20-7	1	0.12	1	0.12	NC	NC	1	
Zinc	7440-66-6	1	0.02	1	0.02	NC	NC	1	
zzTriMethylbenzene, 1,3,5-	108-67-8	1	1	1	1	1	1	1	1
zzzTriMethylbenzene, 1,2,4-	95-63-6	1	1	1	1	1	1	1	1
zzzzButylbenzene	104-51-8	1	1	1	1	1	1	1	1

1: Default values. If there is no Reference Concentration, a non-cancer inhalation RAF was not implied. If there is no Inhalation Unit Risk, a cancer inhalation RAF was n

OIL OR HAZARDOUS MATERIAL	CAS	Relative Absorption Factors (RAFs) Water Subchronic Ingestion	Water Chronic Ingestion	Water Cancer Ingestion	Produce Noncancer Ingestion	Produce Cancer Ingestion	Oral Absorption Efficiency Tox Study OAEnoncance	Oral Absorption Efficiency Tox Study OAEcancer	Outside Effective Predictive Domain	Fraction Absorbed[1] FA
Acenaphthene	83-32-9	1	1				0.92	NC		1
Acenaphthylene	208-96-8	0.91	0.91				0.92	NC	*	1
Acetone	67-64-1	1	1				1	NC		1
Aldrin	309-00-2	1	1	1			0.8	0.8		1
Anthracene	120-12-7	1	1				0.92	NC	*	1
Antimony	7440-36-0	1	1				0.1	NC		1
Arsenic	7440-38-2	1	1	1	1	1	0.98	0.98		1
Barium	7440-39-3	1	1				0.91	NC		1
Benzene	71-43-2	1	1	1			1	1		1
Benzo(a)anthracene	56-55-3	0.91	0.91	1			0.92	0.92	*	1
Benzo(a)pyrene	50-32-8	0.91	0.91	1			0.92	0.92	*	1
Benzo(b)fluoranthene	205-99-2	0.91	0.91	1			0.92	0.92	*	1
Benzo(g,h,i)perylene	191-24-2	0.91	0.91				0.92	NC	*	1
Benzo(k)fluoranthene	207-08-9	0.91	0.91	1			0.92	0.92	*	1
Beryllium	7440-41-7	1	1	1			0.01	0.01		1
Biphenyl, 1,1-	92-52-4	1	1				1	NC		1
Bis(2-chloroethyl)ether	111-44-4			1				0.98		1
Bis(2-chloroisopropyl)ether	39638-32-9	1	1	1			0.98	0.98		1
Bis(2-ethylhexyl)phthalate	117-81-7	1	1	1			1	1	*	0.8
Bromodichloromethane	75-27-4	1	1	1			0.98	0.98		1
Bromoform	75-25-2	1	1	1			0.9	0.9		1
Bromomethane	74-83-9	1	1				0.97	NC		1
Cadmium	7440-43-9	1	1		1		0.07	NC		1
Carbon tetrachloride	56-23-5	1	1	1			1	1		1
Chlordane	12789-03-6	1	1	1	0.91	1	0.8	0.8	*	0.7
Chloroaniline, p-	106-47-8	1	1				1	NC		1
Chlorobenzene	108-90-7	1	1				1	NC		1
Chloroform	67-66-3	1	1				1	1		1
Chlorophenol, 2-	95-57-8	1	1				1	NC		1
Chromium (total)	7440-47-3	1	1		1		0.11	NC		1
Chromium(III)	16065-83-1	1	1		1		0.25	NC		1
Chromium(VI)	18540-29-9	1	1		1		0.11	NC		1
Chrysene	218-01-9	0.91	0.91	1			0.92	0.92	*	1
Cyanide	57-12-5	1	1				1	NC		1

Dibenzo(a,h)anthracene	53-70-3	0.91	0.91	1		0.92	0.92	*	0.6
Dibromochloromethane	124-48-1	1	1	1		0.98	0.98		1
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	1	1			1	NC		1
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	1	1			1	NC		1
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	1	1	1		1	1		1
Dichlorobenzidine, 3,3'-	91-94-1		1	1		0.9	0.9		1
DDD	72-54-8	1	1	1		0.9	0.6	*	0.8
DDE	72-55-9	1	1	1		0.9	0.6	*	0.8
DDT	50-29-3	1	1	1		0.9	0.6	*	0.7
Dichloroethane, 1,1-	75-34-3	1.3	1.3			0.75	NC		1
Dichloroethane, 1,2-	107-06-2	1	1	1		1	1		1
Dichloroethylene, 1,1-	75-35-4	1	1			1	0.98		1
Dichloroethylene, cis-1,2-	156-59-2	1	1			0.84	NC		1
Dichloroethylene, trans-1,2-	156-60-5	1	1			0.84	NC		1
Dichloromethane	75-09-2	1	1	1		1	1		1
Dichlorophenol, 2,4-	120-83-2	1	1			1	NC		1
Dichloropropane, 1,2-	78-87-5			1		1	1		1
Dichloropropene, 1,3-	542-75-6	1	1	1		1	1		1
Dieldrin	60-57-1	1	1	1		0.8	0.8	*	0.8
Diethyl phthalate	84-66-2	1	1			1	NC		1
Dimethyl phthalate	131-11-3	1	1			1	NC		1
Dimethylphenol, 2,4-	105-67-9	1	1			1	NC		1
Dinitrophenol, 2,4-	51-28-5	1	1			1	NC		1
Dinitrotoluene, 2,4-	121-14-2	1	1	1		0.9	0.9		1
Dioxane, 1,4-	123-91-1	1	1	1		1	1		1
Endosulfan	115-29-7	1	1			1	NC	*	1
Endrin	72-20-8	1	1			0.8	NC	*	0.8
Ethylbenzene	100-41-4	1	1			1	NC		1
Ethylene dibromide	106-93-4	1	1	1		1	1		1
Fluoranthene	206-44-0	1	1			0.92	NC	*	1
Fluorene	86-73-7	1	1			0.92	NC	*	1
Heptachlor	76-44-8	1	1	1		0.66	0.66	*	0.8
Heptachlor epoxide	1024-57-3	1	1	1		0.66	0.66	*	1
Hexachlorobenzene	118-74-1	1	1	1		0.8	0.8	*	0.9
Hexachlorobutadiene	87-68-3	1	1	1		1	1	*	0.9
gamma-HCH	58-89-9	1	1	1		1	1		0.9
Hexachloroethane	67-72-1	1	1	1		1	1		1
Hmx	2691-41-0	1	1			0.3	NC		1
Indeno(1,2,3-cd)pyrene	193-39-5	0.91	0.91	1		0.92	0.92	*	0.6
Lead	7439-92-1	0.5	0.5		0.5	0.5	NC		1

Mercury	7439-97-6	1	1				0.95	NC		1
Methoxychlor	72-43-5	1	1				1	NC	*	1
Methyl ethyl ketone	78-93-3	1	1				1	NC		1
Methyl isobutyl ketone	108-10-1	1	1				1	NC		1
Methyl mercury	22967-92-6	1	1				0.95	NC		1
Methyl tert butyl ether	1634-04-4	1	1				1			1
Methylnaphthalene, 2-	91-57-6	1	1				0.92	NC		1
Naphthalene	91-20-3	1	1				0.92	NC		1
Nickel	7440-02-0	1	1			1	0.1	NC		1
N-nitrosodimethylamine (NDMA)	62-75-9			1				1		1
Pentachlorophenol	87-86-5	1	1		1		0.9	0.9	*	0.9
Perchlorate	NA	1	1			1	1			1
Petroleum hydrocarbons	NA									
Aliphatics C5 to C8	NA	1	1				1	NC		1
Aliphatics C9 to C12	NA	1	1				1	NC	*	1
Aliphatics C9 to C18	NA	1	1				1	NC	*	1
Aliphatics C19 to C36	NA	1	1				1	NC	*	1
Aromatics C9 to C10	NA	0.91	0.91				0.92	NC		1
Aromatics C11 to C22	NA	0.91	0.91				0.92	NC	*	1
Phenanthrene	85-01-8	0.91	0.91				0.92	NC	*	1
Phenol	108-95-2	1	1				1	NC		1
Polychlorinated biphenyls (PCBs)	1336-36-3	1	1	1	1	1	0.89	0.89	*	0.5
Pyrene	129-00-0	1	1				0.92	NC	*	1
Rdx	121-82-4	1	1	1			1	1		1
Selenium	7782-49-2	1	1				0.6	NC		1
Silver	7440-22-4	1	1				0.04	NC		1
Styrene	100-42-5	1	1	1			1	1		1
TCDD, 2,3,7,8- (equivalents)	1746-01-6			1			1	1	*	0.5
Tetrachloroethane, 1,1,1,2-	630-20-6	1	1	1			0.7	0.7		1
Tetrachloroethane, 1,1,2,2-	79-34-5			1				0.7		1
Tetrachloroethylene	127-18-4	1	1	1			1	1		1
Thallium	7440-28-0	1	1				1	NC		1
Toluene	108-88-3	1	1				1	NC		1
Trichlorobenzene, 1,2,4-	120-82-1	1	1				1	NC		1
Trichloroethane, 1,1,1-	71-55-6	1	1				1	NC		1
Trichloroethane, 1,1,2-	79-00-5	1	1	1			1	1		1
Trichloroethylene	79-01-6	1	1	1			1	1		1
Trichlorophenol, 2,4,5-	95-95-4	1	1				1	NC		1
Trichlorophenol 2,4,6-	88-06-2			1			1	1		1
Vanadium	7440-62-2	1	1				0.05	NC		1

Vinyl chloride	75-01-4	1	1	1.53			0.98	0.64			I
Xylenes (mixed isomers)	1330-20-7	1	1				1	NC			I
Zinc	7440-66-6	1	1		1		0.46	NC			I
zzTriMethylbenzene, 1,3,5-	108-67-8	1	1	I		I	1		I		I
zzzTriMethylbenzene, 1,2,4-	95-63-6	1	1	I		I	1		I		I
zzzzButylbenzene	104-51-8	1	1	I	1		1	1			I

[1] U.S. EPA (2001) Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim (http://www.epa.gov/superfund/programs/risk/ragse/). Appendix B (Exhibit B-3).

OIL OR HAZARDOUS MATERIAL		Molecular Weight g/mole	log K_{ow}	Permeability Coefficient Kp^1 cm/hr	Henry's Law Constant HLC atm-m3/mol	Metal	Plant Uptake Factor Ksp mg-soil/mg-plant	Outside Effective Predictive Domain	Diffusivity in air, Da (cm^2/s)	REF	Diffusivity in water, Dw (cm^2/s)	REF
Acenaphthene	83-32-9	154	3.92	8.410E-02	1.84E-04				4.21E-02	6	7.69E-06	6
Acenaphthylene	208-96-8	154	4.07	1.056E-01	1.14E-04			*	4.39E-02	47	7.07E-06	48
Acetone	67-64-1	58	-0.24	5.210E-04	3.97E-05				1.24E-01	6	1.14E-05	6
Aldrin	309-00-2	365	3.01	1.389E-03	4.40E-05				1.32E-02	6	4.86E-06	6
Anthracene	120-12-7	178	4.55	1.608E-01	5.56E-05			*	3.24E-02	6	7.74E-06	6
Antimony	7440-36-0	122		1.000E-03		yes						
Arsenic	7440-38-2	75		1.000E-03		yes	0.05					
Barium	7440-39-3	137		1.000E-03		yes						
Benzene	71-43-2	78	2.13	1.476E-02	5.55E-03				8.80E-02	6	9.80E-06	6
Benzo(a)anthracene	56-55-3	228	5.66	4.558E-01	1.20E-05			*	5.10E-02	6	9.00E-06	6
Benzo(a)pyrene	50-32-8	252	6.1	6.528E-01	4.57E-07			*	4.30E-02	6	9.00E-06	6
Benzo(b)fluoranthene	205-99-2	252	6.12	6.730E-01	6.57E-07			*	2.26E-02	6	5.56E-06	6
Benzo(g,h,i)perylene	191-24-2	276	6.51	8.933E-01	3.31E-07			*	4.90E-02	47	5.65E-05	48
Benzo(k)fluoranthene	207-08-9	252	6.06	6.143E-01	5.84E-07			*	2.26E-02	6	5.56E-06	6
Beryllium	7440-41-7	9		1.000E-03		yes						
Biphenyl, 1,1-	92-52-4	154	4.09	1.089E-01	3.08E-04				5.73E-02	47	6.71E-06	48
Bis(2-chloroethyl)ether	111-44-4	143	1.29	1.781E-03	1.70E-05				6.92E-02	47	7.53E-06	48
Bis(2-chloroisopropyl)ether	39638-32-9	171	2.1	4.250E-03	3.32E-04				6.00E-02	6	6.40E-06	6
Bis(2-ethylhexyl)phthalate	117-81-7	391	5.11	2.415E-02	2.70E-07			*	3.51E-02	6	3.66E-06	6
Bromodichloromethane	75-27-4	164	2.09	4.581E-03	2.12E-03				2.98E-02	6	1.06E-05	6
Bromoform	75-25-2	253	2.37	2.225E-03	5.35E-04				1.49E-02	6	1.03E-05	6
Bromomethane	74-83-9	95			7.34E-03				7.28E-02	6	1.21E-05	6
Cadmium	7440-43-9	112		1.000E-03		yes	1.9					
Carbon tetrachloride	56-23-5	154	2.83	1.605E-02	2.76E-02				7.80E-02	6	8.80E-06	6
Chlordane	12789-03-6	410	5.54	3.634E-02	7.03E-05		11	*	1.18E-02	6	4.37E-06	6
Chloroaniline, p-	106-47-8	128	1.85	5.061E-03	1.16E-06				4.83E-02	6	1.01E-05	6
Chlorobenzene	108-90-7	113	2.84	2.764E-02	3.11E-03				7.30E-02	6	8.70E-06	6
Chloroform	67-66-3	119	1.97	6.820E-03	3.67E-03				1.04E-01	6	1.00E-05	6
Chlorophenol, 2-	95-57-8	129	2.16	8.002E-03	1.12E-05				5.01E-02	6	9.46E-06	6
Chromium (total)	7440-47-3	52		2.000E-03		yes	0.095					
Chromium(III)	16065-83-1	52		1.000E-03		yes	0.095					
Chromium(VI)	18540-29-9	52		2.000E-03		yes	0.095					
Chrysene	218-01-9	228	5.66	4.558E-01	5.23E-06			*	2.48E-02	6	6.21E-06	6
Cyanide	57-12-5	27		1.000E-03	2.42E-02	yes						
Dibenzo(a,h)anthracene	53-70-3	278	6.84	1.437E+00	1.23E-07			*	2.02E-02	6	5.18E-06	6
Dibromochloromethane	124-48-1	208	2.17	2.934E-03	7.83E-04				1.96E-02	6	1.05E-05	6
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	147	3.38	4.051E-02	1.92E-03				6.90E-02	6	7.90E-06	6
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	147	3.6	5.660E-02	2.63E-03				6.80E-02	6	8.13E-06	6
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	147	3.39	4.113E-02	2.41E-03				6.90E-02	6	7.90E-06	6
Dichlorobenzidine, 3,3'-	91-94-1	253	3.51	1.258E-02	2.84E-11				1.94E-02	6	6.74E-06	6
DDD	72-54-8	320	5.8	1.722E-01	6.60E-06			*	1.69E-02	6	4.76E-06	6
DDE	72-55-9	318	5.69	1.495E-01	4.16E-05			*	1.44E-02	6	5.87E-06	6

DDT	50-29-3	354	6.36	2.601E-01	8.32E-06			*	1.37E-02	6	4.95E-06	6
Dichloroethane, 1,1-	75-34-3	99	1.79	6.714E-03	5.62E-03				7.42E-02	6	1.05E-05	6
Dichloroethane, 1,2-	107-06-2	99	1.48	4.192E-03	1.18E-03				1.04E-01	6	9.90E-06	6
Dichloroethylene, 1,1-	75-35-4	97	2.13	1.155E-02	2.61E-02				9.00E-02	6	1.04E-05	6
Dichloroethylene, cis-1,2-	156-59-2	97	1.86	7.663E-03	4.08E-03				7.36E-02	6	1.13E-05	6
Dichloroethylene, trans-1,2-	156-60-5	97	1.86	7.663E-03	9.38E-03				7.07E-02	6	1.19E-05	6
Dichloromethane	75-09-2	85	1.25	3.540E-03	3.25E-03				1.01E-01	6	1.17E-05	6
Dichlorophenol, 2,4-	120-83-2	163	2.92	1.638E-02	5.51E-06				3.46E-02	6	8.77E-06	6
Dichloropropane, 1,2-	78-87-5	113	2	7.713E-03	2.82E-03				7.82E-02	6	8.73E-06	6
Dichloropropene, 1,3-	542-75-6	111	1.6	4.309E-03	3.55E-03				6.26E-02	6	1.00E-05	6
Dieldrin	60-57-1	381	4.56	1.191E-02	1.00E-05			*	1.25E-02	6	4.74E-06	6
Diethyl phthalate	84-66-2	222	2.47	3.864E-03	6.10E-07				2.56E-02	6	6.35E-06	6
Dimethyl phthalate	131-11-3	194	1.56	1.391E-03	1.97E-07				5.68E-02	47	6.30E-06	48
Dimethylphenol, 2,4-	105-67-9	122	2.3	1.083E-02	9.51E-07				5.84E-02	6	8.69E-06	6
Dinitrophenol, 2,4-	51-28-5	184	1.55	1.558E-03	8.60E-08				2.73E-02	6	9.06E-06	6
Dinitrotoluene, 2,4-	121-14-2	182	1.98	3.073E-03	5.40E-08				2.03E-01	6	7.06E-06	6
Dioxane, 1,4-	123-91-1	88	-0.32	3.133E-04	4.80E-06				2.30E-01	47	1.00E-05	48
Endosulfan	115-29-7	407	4.1	4.234E-03	6.50E-05			*	1.15E-02	6	4.55E-06	6
Endrin	72-20-8	381	4.56	1.191E-02	6.36E-06			*	1.25E-02	6	4.74E-06	6
Ethylbenzene	100-41-4	106	3.15	4.846E-02	7.88E-03				7.50E-02	6	7.80E-06	6
Ethylene dibromide	106-93-4	188	1.96	2.759E-03	6.50E-04				2.17E-02	47	1.90E-05	48
Fluoranthene	206-44-0	202	4.95	2.167E-01	8.86E-06			*	3.02E-02	6	6.35E-06	6
Fluorene	86-73-7	166	4.21	1.119E-01	9.62E-05			*	3.63E-02	6	7.88E-06	6
Heptachlor	76-44-8	374	4.27	8.391E-03	2.94E-04			*	1.12E-02	6	5.69E-06	6
Heptachlor epoxide	1024-57-3	389	5	2.097E-02	2.10E-05			*	1.32E-02	6	4.23E-06	6
Hexachlorobenzene	118-74-1	285	5.31	1.284E-01	1.70E-03			*	5.42E-02	6	5.91E-06	6
Hexachlorobutadiene	87-68-3	261	4.78	7.820E-02	1.03E-02			*	5.61E-02	6	6.16E-06	6
gamma-HCH	58-89-9	291	3.73	1.077E-02	5.14E-06				1.42E-02	6	7.34E-06	6
Hexachloroethane	67-72-1	237	3.93	2.928E-02	3.89E-03				2.50E-03	6	6.80E-06	6
Hmx	2691-41-0	296.2	0.26	5.163E-05	8.67E-10				4.30E-02	47	4.95E-06	48
Indeno(1,2,3-cd)pyrene	193-39-5	276	6.58	9.936E-01	3.48E-07			*	1.90E-02	6	5.66E-06	6
Lead	7439-92-1	207		1.000E-04		yes	0.15					
Mercury	7439-97-6	201		1.000E-03		yes			3.07E-02	6	6.30E-06	6
Methoxychlor	72-43-5	346	5.08	4.123E-02	2.03E-07			*	1.56E-02	6	4.46E-06	6
Methyl ethyl ketone	78-93-3	72	0.29	9.732E-04	5.69E-05				8.08E-02	47	9.80E-06	48
Methyl isobutyl ketone	108-10-1	100	1.19	2.663E-03	1.38E-04				7.50E-02	47	7.80E-06	48
Methyl mercury	22967-92-6	231		1.000E-03		yes			5.30E-02	47	6.10E-06	48
Methyl tert butyl ether	1634-04-4	88	1.05	2.513E-03	5.87E-04				2.37E-03	47	8.63E-06	48
Methylnaphthalene, 2-	91-57-6	142	3.86	8.962E-02	5.18E-04				6.29E-02	47	7.20E-06	48
Naphthalene	91-20-3	128	3.3	4.584E-02	4.40E-04				5.90E-02	6	7.50E-06	6
Nickel	7440-02-0	59		2.000E-04		yes	0.38					
N-nitrosodimethylamine (NDMA)	62-75-9	74.0822	-0.57	2.564E-04	1.82E-06				1.13E-01	44	1.24E-05	44
Pentachlorophenol	87-86-5	266	5.86	3.784E-01	2.45E-08			*	5.60E-02	6	6.10E-06	6
Perchlorate	NA			0.000E+00								
Petroleum hydrocarbons	NA											
Aliphatics C5 to C8	NA	93	3.85	1.660E-01	1.296				8.00E-02		1.00E-06	6
Aliphatics C9 to C12	NA	149	5.52	1.020E+00	1.56			*	7.00E-02		1.00E-06	6

Aliphatics C9 to C18	NA	170	5.94	1.474E+00	1.656			*	7.00E-02		5.00E-06	6
Aliphatics C19 to C36	NA		11	0.000E+00				*				
Aromatics C9 to C10	NA	120	3.93	1.324E-01	0.00792				7.00E-02		1.00E-06	6
Aromatics C11 to C22	NA	150	5.09	5.241E-01	0.00072			*	6.00E-02		1.00E-06	6
Phenanthrene	85-01-8	178	4.46	1.402E-01	4.23E-05			*	3.33E-02	47	7.47E-06	48
Phenol	108-95-2	94	1.46	4.337E-03	3.33E-07				8.20E-02	6	9.10E-06	6
Polychlorinated biphenyls (PCBs)	1336-36-3	328	6.72	6.286E-01	4.15E-04		0.84	*	1.38E-02	47	4.32E-06	48
Pyrene	129-00-0	202	5.11	2.763E-01	1.19E-05			*	2.72E-02	6	7.24E-06	6
Rdx	121-82-4	222.26	0.87	3.385E-04	6.32E-08				5.20E-02	47	6.00E-06	48
Selenium	7782-49-2	79		1.000E-03		yes						
Silver	7440-22-4	108		6.000E-04		yes						
Styrene	100-42-5	104	2.95	3.669E-02	2.75E-03				7.10E-02	6	8.00E-06	6
TCDD, 2,3,7,8- (equivalents)	1746-01-6	322	6.8	7.670E-01	5.00E-05			*	4.70E-02	6	8.00E-06	6
Tetrachloroethane, 1,1,1,2-	630-20-6	168	3.03	1.816E-02	2.45E-03				7.10E-02	47	7.90E-06	48
Tetrachloroethane, 1,1,2,2-	79-34-5	168	2.39	6.864E-03	3.67E-04				7.10E-02	6	7.90E-06	6
Tetrachloroethylene	127-18-4	166	3.4	3.269E-02	1.77E-02				7.20E-02	6	8.20E-06	6
Thallium	7440-28-0	204		1.000E-03		yes						
Toluene	108-88-3	92	2.73	3.066E-02	6.64E-03				8.70E-02	6	8.60E-06	6
Trichlorobenzene, 1,2,4-	120-82-1	181	3.98	6.504E-02	1.42E-03				7.80E-02	6	8.80E-06	6
Trichloroethane, 1,1,1-	71-55-6	133	2.49	1.255E-02	1.72E-02				7.80E-02	6	8.80E-06	6
Trichloroethane, 1,1,2-	79-00-5	133	2.05	6.430E-03	8.24E-04				7.80E-02	6	8.80E-06	6
Trichloroethylene	79-01-6	131	2.42	1.158E-02	9.85E-03				7.90E-02	6	9.10E-06	6
Trichlorophenol, 2,4,5-	95-95-4	197	3.9	4.686E-02	1.62E-06				2.91E-02	6	7.03E-06	6
Trichlorophenol 2,4,6-	88-06-2	197	3.69	3.406E-02	2.60E-06				3.18E-02	6	6.25E-06	6
Vanadium	7440-62-2	51		1.000E-03		yes						
Vinyl chloride	75-01-4	63	1.36	5.556E-03	2.78E-02				1.06E-01	6	1.23E-06	6
Xylenes (mixed isomers)	1330-20-7	106	3.2	5.229E-02	6.63E-03				7.69E-02	6	8.44E-06	6
Zinc	7440-66-6	65		6.000E-04		yes	1.5					
zzTriMethylbenzene, 1,3,5-	108-67-8	120.2	3.7	9.309E-02	0.00877				0.0602254	6	7.843E-06	6
zzzTriMethylbenzene, 1,2,4-	95-63-6	120.2	3.7	9.309E-02	0.00616				0.0606754	6	7.9209E-06	6
zzzzButylbenzene	104-51-8	134.22	4.29	1.904E-01	0.0159				0.0527732	6	7.3335E-06	6

[1] U.S. EPA (2001) Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim (http://www.epa.gov/superfund/programs/risk/ragse/). Chapter 3 for metals, Appendix B (Exhibit B-2) for organics.

References used in calculating Method 3 Risk

Reference #	Description
t	U.S. EPA, Integrated Risk Information System (IRIS). On-line search: current as of January 10, 2007.
ta	The oral cancer slope factor for a mix of 2,4- and 2,6- Dinitrotoluene (from IRIS) has been used as the cancer slope factor equivalent for pure 2,4-Dinitrotoluene.
tb	The chronic oral RfD for 1,2-Dichlorobenzene has been used as the chronic oral RfD equivalent for t,3-Dichlorobenzene and 1,4-Dichlorobenzene.
tc	IRIS lists two oral RfDs, one for food and one for water exposure. The more conservative is used here.
td	The chronic oral RfD (from IRIS) has been used here as a subchronic oral RfD equivalent.
te	This Cancer Slope Factor or Unit Risk for benzo(a)pyrene (from IRIS) has been applied to the seven PAH compounds which are designated as category A, Bt, B2 or C carcinogens.
1f	This value (Be Oral CSF of 4.3 kg-day/mg) was recently withdrawn form IRIS, although many consultants may continue to use it, lacking any new information.
tg	The chronic oral Reference Dose for DDT has been adopted for DDD and DDE as well.
th	The chronic RfC for Cr VI was used for CR III rather than the old, withdrawn HEAST value of 2E-6 mg/m3, which would imply that Cr III is 50 times more toxic than Cr VI.
1i	The subchronic RfD is based upon the subchronic toxicity data that is the basis of the chronic RfD presented in the IRIS file.
1j	The subchronic RfC is set equal to the chronic RfC based on information about subchronic toxicity presented in the IRIS file.
1k	The subchronic RfC is set equal to a multiple (often, but not always t0) of the chronic RfC based on information about subchronic toxicity presented in the IRIS file.
2	U.S. EPA Health Effects Assessment Summary Tables (HEAST), Annual FY-t992. (OERR 9200.6-303 (92-t), NTIS No. PB92-92t t99) January/July 1992.
2a	This subchronic oral RfD (from HEAST) for t,2-Dichlorobenzene has been used as the subchronic oral RfD equivalent for 1,3- and 1,4- Dichlorobenzene.
2b	The subchronic RfC is set equal to a multiple (often, but not always t0) of the chronic RfC based on information about subchronic toxicity presented in HEAST.
2c	This Cancer Slope Factor or Unit Risk was taken from a fact sheet distributed by the U.S. EPA Superfund Health Risk Technical Support Center at ECAO-Cincinnati, current as of September 2, t992.
2d	This value has been withdrawn from HEAST, although many consultants may continue to use it, lacking any new information. Consult HEAST for any additional information.
2e	from Table 2 of HEAST, calculated by an alternative method.
2f	The chronic Reference Concentration for 1,2-dichlorobenzene has been used for 1,3 dichlorobenzene.
2g	The subchronic oral RfD for DDT has been adopted for DDE and DDD as well.
3	CHEM/AAL
4	Developed for the Risk Assessment ShortForm - Residential Scenario (MA DEP, 1992) by MA DEP staff. Documentation of this value may be found in that document.
4a	This one-time allowable intake for cyanide was developed by MA DEP staff. See documentation on-line at http://www.state.ma.us/dep/ors/files/cn_soil.htm
5	This value was developed by MA DEP ORS Air/Water Toxics staff.
6	US EPA Soil Screening Guidance: Technical Background Document, EPA/540/R95/t28, May t996
6a	Measured Koc from the SSL Guidance, Table 39
6b	Calculated Koc from the SSL Guidance, Table 39
10	Owen, 1990. "Literature Derived Absorption Coefficients for 39 Chemicals via Oral and Inhalation Routes of Exposure"; Regulatory Toxicology and Pharmacology; pp. 237-252; November, t990.
11	United States Environmental Protection Agency (USEPA), t986. "Superfund Public Health Evaluation Manual"; U.S. Environmental Protection Agency ; Office of Emergency and Remedial Response, EPA/540/1-86/060 (OSWER Directive 9285.4-1); Washington, D.C., Oct
12	USEPA, t992. "Dermal Exposure Assessment: Principles and Applications"; U.S. Environmental Protection Agency; Office of Research and Development, EPA/600/8-91/01tB; Washington, D.C., January t992.
13	ATSDR, "Toxicological Profile for _____"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. The ATSDR profile for the chemical of interest was used as a source of this value.
14.a. - t4.l	USEPA Test Methods for Evaluating Solid Waste, SW-846, Third Edition (Revision O), November t986.
15.a. - t5.d.	Guide to Environmental Analytical Methods, Robert E. Wagner, editor; Genium Publishing Corporation, Schenectady, NY; 1992.
16	From CLP Statement of Work for Inorganic Analytes, 8/90, Document Number ILM01.t
17	Standard Methods for the Examination of Water and Wastewater, 17th edition; Water Environment Federation.
t8	Federal Register 40 CFR t4t:23:3579 (January 30, 199t).
19	USEPA Method 1613.
20	U.S. Department of Defense, 1989
2t	U.S. EPA Draft Health Advisory for Methyl t-Butyl Ether, 1989.
22	Oregon Department of Environmental Quality, Development of Generic Soil Cleanup Levels Based On Analysis Of The Leachate Pathway, May t2, t992.
23	See Appendix G: Application of SESOIL Model
24	Handbook of Environmental Data on Organic Chemicals, 2nd edition, Karel Verschueren; Van Nostrand Reinhold Co. Inc., NY; 1983. Reference #
25	Compilation of Odor and Taste Threshold Values Data, F.A. Fazzalari, editor; ASTM Data Service DS48A; 1978.

References used in calculating Method 3 Risk

Reference #	Description
27	USEPA, 1992. "Reference Guide to Odor Thresholds for Hazardous Air Pollutants Listed in the Clean Air Act Amendment of 1990", U.S. Environmental Protection Agency; Office of Research and Development, EPA/600/R-92/047; Washington, D.C., March 1992.
28	USEPA, 1992. "Indoor Air Quality Database for Organic Compounds", U.S. Environmental Protection Agency; Research Triangle Park, NC, February 1992.
29	Risk Reduction Engineering Laboratory (RREL) Treatability Database, Version 4.0.
30	U.S. Department of Defense, 1991. "Defense Priority Model Users Manual", FY 1992 version; Washington, D.C.
31	Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MassDEP VPH/EPH Approach (MassDEP, 2002) Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology (MassDEP, November 2003).
32	Chemical Health Effects Assessment Methodology and the Method to Derive Allowable Ambient Limits (CHEM/AAL). ORS Report 90-1.
33	OSHA Documentation of TLV -TWA
34	from a summary table in Tsedash Zewdie
35	Conversion of the oral Cancer Slope Factor to the Inhalation Unit Risk, using the equation: Slope Factor x Ventilation Rate x Constant / Body Weight (CSF x V x C)/BW = (CSF x 20 m^3/day x 0.001 mg/µg) / 70 kg
36	From Texas NRCC document for soil standards
37	Training Workshop for Massachusetts Certified Laboratories - Handout Material - MA DEPDivision of Environmental Analysis, Wall Experiment Station (8/21/95)
38	Koc for 1,1-Biphenyl from Montgomery (Andrew Friedmann, ORS)
39	Conversion of the oral Reference Dose to a Reference Concentration, using the equation: RfD x BW / Ventilation Rate (RfD x BW) / VR = RfD x 70 kg / (20 m^3/day)
40	The Subchronic Inhalation Reference Concentration for this chemical is taken to be equal to the chronic value, absent clear chemical-specific information justifying a higher value..
41	MA DEP (2004) Perchlorate Toxicological Profile And Health Assessment. (http://www.mass.gov/dep/ors/files/chemical.htm)
42	http://chemfinder.cambridgesoft.com
43	http://esc.syrres.com
44	Toxicity value consistent with approach presented in "Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology" MA DEP 2003 and "Characterizing Risks Posed by Petroleum Contaminated Sites" MA DEP 2002.
45	Conversion of the subchronic Reference Concentration to a subchronic inhalation Reference Dose using the equation: RfC x Ventilation Rate/ Body Weight (RfC x BW) / V = (RfC x 70 kg) / 20 m^3/day
46	Conversion of the Inhalation Unit Risk Factor to an Inhalation Cancer Slopoe Facotr using the equation: URF x Conversion Factor x Body Weight / Ventilation Rate (URF x CF x V) / BW = (URF x 1000 x 20 m^3/day) / 70 kg
47	Calculated according to the FSG Method presented in Chapter 17 of "The Handbook of Chemical Property Estimation Methods" by WJ Lyman, WF Reehl, and DH Rosenblatt, 1982.
48	Calculated according to the Hayduk-Laudie Method presented in Chapter 17 of "The Handbook of Chemical Property Estimation Methods" by WJ Lyman, WF Reehl, and DH Rosenblatt, 1982.
AL	Action Level in drinking water. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
MMCL	Massachusetts Maximum Contaminant Level in drinking water. 310 CMR 22. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
SMCL	Secondary Maximum Contaminant Level in drinking water. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
NA	Not Available
NC	Not Calculated.
ORSGL	Massachusetts DEP Drinking Water Guideline developed by the Office of Research and Standards for the Drinking Water Program. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines

Body Weight Calculations:

Age (years)	50th Percentile Body Weight Females kg	number of years		
1<2	10.7	1		
2<3	12.7	1		
3<4	14.7	1		
4<5	16.7	1		
5<6	19	1		
6<7	21.3	1	Average	
7<8	23.8	1	1-8:	17.0 kg
8<9	27.5	1		
9<10	29.7	1		
10<11	34.5	1		
11<12	40.3	1		
12<13	45.4	1		
13<14	49	1	Average	
14<15	53.1	1	8-15:	39.9 kg
15<16	53.3	1		
16<17	55.6	1		
17<18	58.4	1		
18<25	58	7	Average	
25<31	60.9	6	15 - 30:	58.7 kg
25<35	60.9	10	Average	
35-45	63.4	10	18<45:	61.1 kg

Surface Area/Adherence Factor Calculations (S-1):

Age (years)	years	Head cm2	Face (1/3 of head) cm2	Face Soil Adherence mg/cm2	Forearms cm2	Forearms Soil Adherence mg/cm2	Hands cm2	Hands Soil Adherence mg/cm2	Lower Legs cm2	Lower Legs Soil Adherence mg/cm2	Feet cm2	Feet Soil Adherence mg/cm2	
1<2	1	855.2	282.216		305.8		274.7		481		326.5		
2<3	1	822.2	271.326		341.6		306.9		537.3		411.1		
3<4	1	882.6	291.258		467.3		395.9		697.8		467.3		
4<5	1	974.3	321.519		494.2		402.4		785.1		515.4		
5<6	1	1075	354.75		545.3		444		866.2		568.7		
6<7	1	1104.3	364.419		552.2		396.2		913.8		581.7		
7<8	1	1201.3	396.429		600.6		431		994		632.7		Adherence Factor
1<8	7	988	326	0.006	472	0.027	379	1.5	754	0.2	500	0.26	0.35
8<9	1	1310	432.3		655		470		1084		690		
9<10	1	1272	419.76		651.9		561.8		1216.9		805.6		
10<11	1	1404	463.32		719.6		620.1		1343.2		889.2		
11<12	1	1560	514.8		799.5		689		1492.4		988		
12<13	1	1223.6	403.788		959		756		1708		980		
13<14	1	1475.6	486.948		895.4		754.8		1894.4		1184		
14<15	1	1545.4	509.982		937.8		790.5		1984		1240		Adherence Factor
8<15	7	1399	462	0.0574	803	0.082	663	0.318	1532	0.0419	968	0.26	0.14
15<16	1	1249.7	412.401		949.9		800.7		2009.6		1256		
16<17	1	1273.6	420.288		1048		912		2150.4		1104		
17<18	1	1297.5	428.175		1426.3		831.3		2008.2		1189.9		
18<25	7	1110	366.3		1150		817		2180		1140		
25<31	6	1110	366.3		1150		817		2180		1140		Adherence Factor
18<31	16	1141	376	0.0574	1148	0.082	823	0.318	2157	0.0419	1148	0.2563	0.13

APPENDIX K

MassDEP SHORTFORM METHOD 3 RISK CHARACTERIZATION

RELATIVE TO NATIVE SOIL AT RTN 3-23606

EXCLUSIVE OF RTN 3-28545 AND RTN 3-28546

CLEAN PROPERTIES, INC., 111 Boston Post Road, Suite 211, Sudbury, MA 01776
Phone: 978-443-6622 Fax: 781-577-1510 Email: Public@CleanProperties.com

Method 3 Risk Assessment for Resident Exposed to Chemicals in Soil - Shortform 2006 (sf06rs)

Index

Tab	
EPCs	Table RS-1: Select chemicals and enter Exposure Point Concentrations (EPCs). Associated risks are shown to the right.
C Eq	Table RS-2: Equations to calculate cancer risks.
cNC Eq	Table RS-3: Equations to calculate chronic noncancer risks.
scNC Eq	Table RS-4: Equations to calculate subchronic noncancer risks.
Exp	Table RS-5: Definitions and exposure factors.
Produce	Table RS-6: Equations to calculate produce ingestion rate.
Chem	Table RS-7: Chemical-specific data.

Spreadsheets designed by Andrew Friedmann, MassDEP
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Resident - Soil: Table RS-1
Exposure Point Concentration (EPC)
Based on Resident Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 4-06

Vlookup Version v0808

ELCR (all chemicals) = 8E-07

Chronic HI (all chemicals) = 2E-02

Subchronic HI (all chemicals) = 5E-03

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	$ELCR_{ingestion}$	$ELCR_{dermal}$	$ELCR_{vegetable}$	$ELCR_{total}$	Chronic HQ_{ing}	Chronic HQ_{derm}	Chronic $HQ_{vegetable}$	Chronic HQ_{total}	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic $HQ_{vegetable}$	Subchronic HQ_{total}
Benzene	1.3E-01	2.7E-09	2.2E-09		4.9E-09	7.9E-05	5.4E-05		1.3E-04	8.7E-05	4.1E-05		1.3E-04
Toluene	5.1E-01					1.5E-05	1.6E-05		3.1E-05	4.3E-06	3.0E-06		7.2E-06
Ethylbenzene	2.8E-01					6.9E-06	1.2E-05		1.9E-05	1.9E-06	2.2E-06		4.1E-06
Xylenes (mixed isomers)	2.0E+00					2.4E-05	2.5E-05		4.9E-05	6.7E-05	4.7E-05		1.1E-04
Naphthalene	1.2E+00					5.2E-05	1.2E-04		1.8E-04	1.4E-05	2.3E-05		3.8E-05
Aliphatics C5 to C8	2.0E+01					1.2E-03	1.0E-02		1.2E-02	3.4E-04	2.0E-03		2.3E-03
Aliphatics C9 to C12	1.4E+01					3.4E-04	1.4E-03		1.8E-03	9.3E-05	2.7E-04		3.7E-04
Aromatics C9 to C10	1.1E+01					8.9E-04	3.8E-03		4.7E-03	2.4E-04	7.2E-04		9.6E-04
Aliphatics C9 to C18	5.4E+00					1.3E-04	5.5E-04		6.8E-04	3.6E-05	1.0E-04		1.4E-04
Aliphatics C19 to C36	9.6E+00					1.2E-05	9.9E-06		2.1E-05	1.1E-05	6.2E-06		1.7E-05
Aromatics C11 to C22	1.3E+01					3.8E-04	8.9E-04		1.3E-03	1.0E-04	1.7E-04		2.7E-04
Methylnaphthalene, 2-	2.4E-01					5.2E-05	1.2E-04		1.8E-04	1.4E-04	2.3E-04		3.8E-04
Phenanthrene	3.1E-01					9.0E-06	2.1E-05		3.0E-05	2.5E-06	4.0E-06		6.5E-06
Acenaphthylene	2.5E-01					7.3E-06	1.7E-05		2.4E-05	2.0E-06	3.3E-06		5.3E-06
Acenaphthene	2.4E-01					3.5E-06	8.2E-06		1.2E-05	9.6E-07	1.6E-06		2.5E-06
Fluorene	2.4E-01					5.2E-06	1.2E-05		1.8E-05	1.4E-06	2.3E-06		3.8E-06
Anthracene	2.4E-01					7.0E-07	1.6E-06		2.3E-06	1.9E-07	3.1E-07		5.0E-07
Fluoranthene	3.6E-01					7.9E-06	1.9E-05		2.6E-05	2.2E-06	3.5E-06		5.7E-06
Pyrene	3.5E-01					1.0E-05	2.4E-05		3.4E-05	2.8E-06	4.6E-06		7.4E-06
Benzo(a)anthracene	2.7E-01	2.1E-08	1.5E-08		3.6E-08	6.1E-06	3.7E-06		9.8E-06	1.7E-06	7.0E-07		2.4E-06
Chrysene	3.0E-01	2.3E-09	1.7E-09		4.0E-09	6.8E-06	4.1E-06		1.1E-05	1.9E-06	7.8E-07		2.6E-06
Benzo(b)fluoranthene	2.8E-01	2.1E-08	1.6E-08		3.7E-08	6.3E-06	3.8E-06		1.0E-05	1.7E-06	7.3E-07		2.5E-06
Benzo(k)fluoranthene	2.7E-01	2.1E-09	1.5E-09		3.6E-09	6.1E-06	3.7E-06		9.8E-06	1.7E-06	7.0E-07		2.4E-06
Benzo(a)pyrene	2.8E-01	2.1E-07	1.6E-07		3.7E-07	6.3E-06	3.8E-06		1.0E-05	1.7E-06	7.3E-07		2.5E-06
Indeno(1,2,3-cd)pyrene	2.7E-01	2.1E-08	1.5E-08		3.6E-08	6.1E-06	3.7E-06		9.8E-06	1.7E-06	7.0E-07		2.4E-06
Dibenzo(a,h)anthracene	2.5E-01	1.9E-07	1.4E-07		3.3E-07	5.7E-06	3.4E-06		9.1E-06	1.6E-06	6.5E-07		2.2E-06
Benzo(g,h,i)perylene	4.2E-01					1.2E-05	2.9E-05		4.1E-05	3.4E-06	5.5E-06		8.8E-06

Resident - Soil: Table RS-2
Equations to Calculate Cancer Risk for Resident (Age 1-31 years)

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing(1\text{-}31)} * CSF$$

$$LADD_{ing\ (1\text{-}31)} = LADD_{ing\ (1\text{-}8)} + LADD_{ing\ (8\text{-}15)} + LADD_{ing\ (15\text{-}31)}$$

$$LADD_{ing\ (age\ group\ x)} = \frac{[OHM]_{soil} * IR_x * RAF_{c\text{-}ing} * EF_{ing} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm\ (1\text{-}31)} = LADD_{derm\ (1\text{-}8)} + LADD_{derm\ (8\text{-}15)} + LADD_{derm\ (15\text{-}31)}$$

$$LADD_{derm(age\ group\ x)} = \frac{[OHM]_{soil} * SA_x * RAF_{c\text{-}derm} * SAF_x * EF_{derm} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Cancer Risk from Homegrown Produce

$$ELCR_{produce} = LADD_{produce(1\text{-}31)} * CSF$$

$$LADD_{produce(1\text{-}31)} = LADD_{produce(1\text{-}8)} + LADD_{produce(8\text{-}15)} + LADD_{produce(15\text{-}31)}$$

$$LADD_{produce(age\ x)} = \frac{[OHM_{soil}] * PUF * PIR_x * RAF_{produce} * EF_{produce} * ED * EP_x * C}{BW_x * AP_{lifetime}}$$

Vlookup Version v0808

Parameter	Value	Units
CSF	OHM specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
$IR_{(1\text{-}8)}$	100	mg/day
$IR_{(8\text{-}15)}$	50	mg/day
$IR_{(15\text{-}31)}$	50	mg/day
$PIR_{(1\text{-}8)}$	12,099	mg/day
$PIR_{(8\text{-}15)}$	17,809	mg/day
$PIR_{(15\text{-}31)}$	24,420	mg/day
$RAF_{c\text{-}ing}$	OHM specific	dimensionless
$RAF_{c\text{-}derm}$	OHM specific	dimensionless
$RAF_{c\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.412	event/day
$EF_{produce}$	1.00	event/day
ED	1	day/event
$EP_{(1\text{-}8)}$	7	years
$EP_{(8\text{-}15)}$	7	years
$EP_{(15\text{-}31)}$	16	years
C	0.000001	kg/mg
$BW_{(1\text{-}8)}$	17.0	kg
$BW_{(8\text{-}16)}$	39.9	kg
$BW_{(16\text{-}31)}$	58.7	kg
$AP_{(lifetime)}$	70	years
$SA_{(1\text{-}8)}$	2431	cm^2 / day
$SA_{(8\text{-}15)}$	4427	cm^2 / day
$SA_{(15\text{-}31)}$	5653	cm^2 / day
$SAF_{(1\text{-}8)}$	0.35	mg/cm^2
$SAF_{(8\text{-}15)}$	0.14	mg/cm^2
$SAF_{(15\text{-}31)}$	0.13	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Resident - Soil: Table RS-3
Equations to Calculate Chronic Noncancer Risk for Resident Child (Age 1-8 years)

Vlookup Version v0808

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD}$$

$$ADD_{produce} = \frac{[OHM_{soil}] * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	100	mg/day
PIR	12,099	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$RAF_{nc\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.412	event/day
$EF_{produce}$	1.00	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
EP	7	years
$EP_{cyanide}$	1	day
C	0.000001	kg/mg
BW	17.0	kg
AP	7	year
$AP_{cyanide}$	1	day
SA	2431	cm^2 / day
SAF	0.35	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Resident - Soil: Table RS-4
Equations to Calculate Subchronic Noncancer Risk for Resident Child (Age 1-2 years)

Vlookup Version v0808

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Homegrown Produce

$$HQ_{produce} = \frac{ADD_{produce}}{RfD_{subchronic}}$$

$$ADD_{produce} = \frac{[OHM_{soil}] * PUF * PIR * RAF_{produce} * EF_{produce} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	100	mg/day
PIR	10,900	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$RAF_{nc\text{-}produce}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.714	event/day
$EF_{produce}$	1.00	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
$EP_{cyanide}$	1	day
EP	0.577	years
C	0.000001	kg/mg
BW	10.7	kg
AP	0.577	year
$AP_{cyanide}$	1	day
SA	1670	cm^2 / day
SAF	0.35	mg/cm^2
PUF	OHM specific	$(mg/mg)(mg/mg)^{-1}$

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Resident - Soil: Table RS-5
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
LADE - Lifetime Average Daily Exposure	chemical specific	$\mu g/m^3$	
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
ADE - Average Daily Exposure	chemical specific	mg/m^3	
EPC - Exposure Point Concentration	chemical specific	mg/kg	
PUF - Plant Uptake Factor	chemical specific	$(mg/mg)(mg/mg)^{-1}$	See Table RS-7; $(mg_{OHM}/mg_{plant})/(mg_{OHM}/mg_{soil})^{-1}$
$IR_{(1-2)}$ - Soil Ingestion Rate for age group 1-2	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
$IR_{(1-8)}$ - Soil Ingestion Rate for age group 1-8	100	mg/day	Ibid
$IR_{(8-15)}$ - Soil Ingestion Rate for age group 8-15	50	mg/day	Ibid
$IR_{(15-31)}$ - Soil Ingestion Rate for age group 15-31	50	mg/day	Ibid
$PIR_{(1-2)}$ = Produce Ingestion Rate for age group 1-2	10,900	mg/day	see Table RS-6
$PIR_{(1-8)}$ = Produce Ingestion Rate for age group 1-8	12,099	mg/day	see Table RS-6
$PIR_{(8-15)}$ = Produce Ingestion Rate for age group 8-15	17,809	mg/day	Ibid
$PIR_{(15-31)}$ = Produce Ingestion Rate for age group 15-31	24,420	mg/day	Ibid
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
$EF_{subchronic}$ - Exposure Frequency for subchronic ingestion or dermal exposure	0.714	event/day	5 days/week
$EF_{chronic}$ - Exposure Frequency for chronic ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
EF_{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.412	event/day	5 days/week, 30 weeks/year
$EF_{produce}$ - Exposure Frequency for produce ingestion, cancer and noncancer	1.00	event/day	
$EF_{cyanide}$ - Exposure Frequency for subchronic and chronic non-cancer cyanide	1.00	event/day	
ED - Exposure Duration	1	day/event	
$EP_{(1-2)}$ - Exposure Period for age group 1-2	0.577	years	30 weeks
$EP_{(1-8)}$ - Exposure Period for age group 1-8	7	years	
$EP_{(8-15)}$ - Exposure Period for age group 8-15	7	years	
$EP_{(15-31)}$ - Exposure Period for age group 15-31	16	years	
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$BW_{(1-2)}$ - Body Weight for age group 1-2	10.7	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, females.
$BW_{(1-8)}$ - Body Weight for age group 1-8	17.0	kg	Ibid
$BW_{(8-15)}$ - Body Weight for age group 8-15	39.9	kg	Ibid
$BW_{(15-31)}$ - Body Weight for age group 15-31	58.7	kg	Ibid
$AP_{subchronic}$ - Averaging Period for subchronic noncancer	0.577	years	30 weeks
$AP_{chronic}$ - Averaging Period for chronic noncancer	7	years	
AP_{cancer} - Averaging Period for lifetime	70	years	
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$SA_{(1-2)}$ - Surface Area for age group 1-2	1670	cm^2 / day	50th percentile of face (1/3 head), forearms, hands, lower legs, and feet for females MADEP. 1995. Guidance for Disposal Site Risk Characterization. Appendix Table B-2.
$SA_{(1-8)}$ - Surface Area for age group 1-8	2431	cm^2 / day	Ibid
$SA_{(8-15)}$ - Surface Area for age group 8-15	4427	cm^2 / day	Ibid
$SA_{(15-31)}$ - Surface Area for age group 15-31	5653	cm^2 / day	Ibid
$SAF_{(1-2)}$. Surface Adherence Factor for age group 1-2	0.35	mg/cm^2	All SAFs developed for ShortForm according to procedure outlined in MA DEP Technical Update:
$SAF_{(1-8)}$. Surface Adherence Factor for age group 1-8	0.35	mg/cm^2	Weighted Skin-Soil Adherence Factors, April 2002
$SAF_{(8-15)}$ - Surface Adherence Factor for age group 8-15	0.14	mg/cm^2	
$SAF_{(15-31)}$ - Surface Adherence Factor for age group 15-31	0.13	mg/cm^2	

Resident - Soil: Table RS-6
Homegrown Produce Ingestion Rate

Data on mean produce ingestion rates (wet weight, ww) in the Northeast was obtained from the 1994-1996 Continuing Survey of Food Intakes by Individuals (USDA). Data for both genders were used for children under 6, while data for males was used for individuals 6 and older. The mean ingestion rates presented in the survey represent the arithmetic average of all individuals surveyed, regardless of whether or not they had consumed the produce item (e.g., an individual that did not consume the produce item was assigned a rate of 0 g/day). To determine the mean ingestion rate for individuals who ate each produce item, the ingestion rate for all individuals (consumers and nonconsumers) was divided by the percentage of individuals who ate the item (Table RS-6A). These mean ingestion rates for the produce consumers were summed to determine the total produce ingestion rate for each age-group and converted to dry weight assuming the produce items were all 90% water.

To convert mean ingestion rates for the age-groups studied in the survey to age-groups used in risk calculations, each age-group ingestion rate from the survey (i.e., 1 - 2 year olds, 3 - 5 year olds, 6 - 11 year olds, 12 - 19 year olds, and 20 - 39 year olds) was weighted according to the number of years spent in the risk calculation age group (i.e., 1 - 8 year olds, 8 - 15 year olds, and 15 - 31 year olds) (Table RS-6B). It was assumed that 25% of produce ingested was home-grown (Table RS-6C).

Table RS-6A

Age-groups studied in survey	White Potatoes: Ingestion Rate for All g/d (ww)	White Potatoes: % of individuals that consumed item.	White Potatoes: Ingestion Rate for Consumers g/d (ww)	Dark-green vegetables: Ingestion Rate for All g/d (ww)	Dark-green vegetables: % of individuals that consumed item.	Dark-green vegetables: Ingestion Rate for Consumers g/d (ww)	Deep-yellow vegetables: Ingestion Rate for All g/d (ww)	Deep-yellow vegetables: % of individuals that consumed item.	Deep-yellow vegetables: Ingestion Rate for Consumers g/d (ww)
1-2	28	40.3	69.5	6	10.1	59.4	5	12.7	39.4
3-5	30	37.1	80.9	5	6.5	76.9	7	12.7	55.1
6-11	47	44.2	106.3	6	9.1	65.9	2	8.5	23.5
12-19	59	40.3	146.4	2	2.3	87.0	11	15.8	69.6
20-39	76	45.1	168.5	25	14.7	170.1	4	5.7	70.2

Age-groups studied in survey	Tomatoes: Ingestion Rate for All g/d (ww)	Tomatoes: % of individuals that consumed item.	Tomatoes: Ingestion Rate for Consumers g/d (ww)	Lettuce: Ingestion Rate for All g/d (ww)	Lettuce: % of individuals that consumed item.	Lettuce: Ingestion Rate for Consumers g/d (ww)	Green Beans: Ingestion Rate for All g/d (ww)	Green Beans: % of individuals that consumed item.	Green Beans: Ingestion Rate for Consumers g/d (ww)
1-2	10	27.9	35.8	1	6	16.7	7	12.1	57.9
3-5	10	37.1	27.0	4	14	28.6	3	5.7	52.6
6-11	20	42	47.6	8	14.9	53.7	1	2	50.0
12-19	29	45.2	64.2	19	28.7	66.2	2	2.4	83.3
20-39	48	50.9	94.3	18	29.6	60.8	4	3.7	108.1

Table RS-6A (continued)

Corn, Green peas, Lima beans: Ingestion	Corn, Green peas, Lima beans: Ingestion	Melons, berries: Ingestion	Melons, berries: Ingestion	Totals: Wet Weight	Totals: Dry Weight

Age-groups studied in survey	Rate for All g/d (ww)	% of individuals that consumed item.	Rate for Consumers g/d (ww)	Rate for All g/d (ww)	% of individuals that consumed item.	Rate for Consumers g/d (ww)	WWI g/day	DWI g/day
1-2	12	15	80.0	7	9	77.8	436.4	43.6
3-5	14	21.7	64.5	14	11.6	120.7	506.3	50.6
6-11	9	13.6	66.2	5	5.9	84.7	498.0	49.8
12-19	14	9.9	141.4	17	5	340.0	998.1	99.8
20-39	12	7.3	164.4	6	4.5	133.3	969.7	97.0

Table RS-6B

Age-groups studied in survey	Years spent in age-group for 1-8 year old	Years spent in age-group for 8-15 year old	Years spent in age-group for 15-31 year old
1-2	2		
3-5	3		
6-11	2	4	
12-19		3	4
20-39			12
	7	7	16

Table RS-6C

	Produce Intake, dry weight			
	Child 1-2 years g/day	Child 1-8 years g/day	Child 8-15 years g/day	Adult 15-31 g/day
All Produce:	43.6	48.4	71.2	97.7
Homegrown:	10.9	12.1	17.8	24.4

Resident - Soil: Table RS-7
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	CSF $(mg/kg\text{-}day)^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	$RAF_{c\text{-}prod}$	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic $RAF_{nc\text{-}ing}$	Chronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$	$RAF_{nc\text{-}prod}$	PUF
Benzene	5.5E-02	1.00	0.08		4.0E-03	1.0E-02	1	0.08	1	0.08		
Toluene					8.0E-02	8.0E-01	1	0.12	1	0.12		
Ethylbenzene					1.0E-01	1.0E+00	1	0.2	1	0.2		
Xylenes (mixed isomers)					2.0E-01	2.0E-01	1	0.12	1	0.12		
Naphthalene					2.0E-02	2.0E-01	0.36	0.1	0.36	0.1		
Aliphatics C5 to C8					4.0E-02	4.0E-01	1	1	1	1		
Aliphatics C9 to C12					1.0E-01	1.0E+00	1	0.5	1	0.5		
Aromatics C9 to C10					3.0E-02	3.0E-01	1	0.5	1	0.5		
Aliphatics C9 to C18					1.0E-01	1.0E+00	1	0.5	1	0.5		
Aliphatics C19 to C36					2.0E+00	6.0E+00	1	0.1	1	0.1		
Aromatics C11 to C22					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
Methylnaphthalene, 2-					4.0E-03	4.0E-03	0.36	0.1	0.36	0.1		
Phenanthrene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
Acenaphthylene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
Acenaphthene					6.0E-02	6.0E-01	0.36	0.1	0.36	0.1		
Fluorene					4.0E-02	4.0E-01	0.36	0.1	0.36	0.1		
Anthracene					3.0E-01	3.0E+00	0.36	0.1	0.36	0.1		
Fluoranthene					4.0E-02	4.0E-01	0.36	0.1	0.36	0.1		
Pyrene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		
Benzo(a)anthracene	7.3E-01	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Chrysene	7.3E-02	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(b)fluoranthene	7.3E-01	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(k)fluoranthene	7.3E-02	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(a)pyrene	7.3E+00	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Indeno(1,2,3-cd)pyrene	7.3E-01	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Dibenzo(a,h)anthracene	7.3E+00	0.28	0.02		3.0E-02	3.0E-01	0.28	0.02	0.28	0.02		
Benzo(g,h,i)perylene					3.0E-02	3.0E-01	0.36	0.1	0.36	0.1		

Method 3 Risk Assessment for Chemicals in Soil - Construction Worker Shortform 2008 (sf08cw)

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Exp	Table CW-4: Definitions and exposure factors.
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Spreadsheets designed by Andrew Friedmann, MassDEP

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Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk
Based on Construction Worker 18-25 years of age

ShortForm Version 08-08

Vlookup Version v0808

ELCR (all chemicals) = 2E-08

HI (all chemicals) = 1E-03

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material (OHM)	EPC (mg/kg)	ELCR ingestion	ELCR dermal	ELCR inhalation GI	ELCR inhalation pulmonary	$ELCR_{total}$	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic HQ_{inh-GI}	Subchronic HQ_{inh}	HQ_{total}
Benzene	1.3E-01	6.3E-11	5.1E-11	1.6E-12	2.7E-13	1.2E-10	1.6E-05	1.3E-05	4.1E-07	5.4E-08	2.9E-05
Toluene	5.1E-01						7.9E-07	9.5E-07	2.0E-08	3.8E-09	1.8E-06
Ethylbenzene	2.8E-01						3.5E-07	7.0E-07	9.1E-09	1.1E-08	1.1E-06
Xylenes (mixed isomers)	2.0E+00						1.2E-05	1.5E-05	3.2E-07	2.5E-07	2.8E-05
Naphthalene	1.2E+00						2.7E-06	7.4E-06	6.9E-08	1.5E-05	2.5E-05
Aliphatics C5 to C8	2.0E+01						6.2E-05	6.2E-04	1.6E-06	3.7E-06	6.9E-04
Aliphatics C9 to C12	1.4E+01						1.7E-05	8.7E-05	4.5E-07	8.7E-07	1.1E-04
Aromatics C9 to C10	1.1E+01						4.5E-05	2.3E-04	1.2E-06	8.2E-07	2.7E-04
Aliphatics C9 to C18	5.4E+00						6.6E-06	3.3E-05	1.7E-07	3.3E-07	4.0E-05
Aliphatics C19 to C36	9.6E+00						2.0E-06	2.0E-06	5.1E-08		4.0E-06
Aromatics C11 to C22	1.3E+01						1.9E-05	5.4E-05	5.0E-07	9.7E-07	7.4E-05
Methylnaphthalene, 2-	2.4E-01						2.7E-05	7.4E-05	6.9E-07	1.8E-08	1.0E-04
Phenanthrene	3.1E-01						4.6E-07	1.3E-06	1.2E-08	2.3E-08	1.8E-06
Acenaphthylene	2.5E-01						3.7E-07	1.0E-06	9.6E-09	1.9E-08	1.4E-06
Acenaphthene	2.4E-01						1.8E-07	5.0E-07	4.6E-09	1.8E-08	7.0E-07
Fluorene	2.4E-01						2.7E-07	7.4E-07	6.9E-09	1.8E-08	1.0E-06
Anthracene	2.4E-01						3.5E-08	9.9E-08	9.2E-10	1.8E-08	1.5E-07
Fluoranthene	3.6E-01						4.0E-07	1.1E-06	1.0E-08	2.7E-08	1.6E-06
Pyrene	3.5E-01						5.2E-07	1.4E-06	1.3E-08	2.6E-08	2.0E-06
Benzo(a)anthracene	2.7E-01	4.8E-10	3.5E-10	1.3E-11	1.5E-11	8.6E-10	3.1E-07	2.2E-07	8.0E-09	2.0E-08	5.6E-07
Chrysene	3.0E-01	5.4E-11	3.9E-11	1.4E-12	1.7E-12	9.6E-11	3.4E-07	2.5E-07	8.9E-09	2.2E-08	6.2E-07
Benzo(b)fluoranthene	2.8E-01	5.0E-10	3.6E-10	1.3E-11	1.5E-11	8.9E-10	3.2E-07	2.3E-07	8.3E-09	2.1E-08	5.8E-07
Benzo(k)fluoranthene	2.7E-01	4.8E-11	3.5E-11	1.3E-12	1.5E-12	8.6E-11	3.1E-07	2.2E-07	8.0E-09	2.0E-08	5.6E-07
Benzo(a)pyrene	2.8E-01	5.0E-09	3.6E-09	1.3E-10	1.5E-10	8.9E-09	3.2E-07	2.3E-07	8.3E-09	2.1E-08	5.8E-07
Indeno(1,2,3-cd)pyrene	2.7E-01	4.8E-10	3.5E-10	1.3E-11	1.5E-11	8.6E-10	3.1E-07	2.2E-07	8.0E-09	2.0E-08	5.6E-07
Dibenzo(a,h)anthracene	2.5E-01	4.5E-09	3.2E-09	1.2E-10	1.4E-10	8.0E-09	2.9E-07	2.1E-07	7.4E-09	1.9E-08	5.2E-07
Benzo(g,h,i)perylene	4.2E-01						6.2E-07	1.7E-06	1.6E-08	3.1E-08	2.4E-06

Construction Worker - Soil: Table CW-2
Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c\text{-}ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c\text{-}derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh\text{-}GI} = LADD_{inh\text{-}GI} * CSF_{oral}$$

$$LADD_{inh\text{-}GI} = \frac{EPC * RCAF_{inh\text{-}gi} * PM_{10} * VR_{work} * RAF_{c\text{-}ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c\text{-}inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
$RAF_{c\text{-}ing}$	OHM-specific	dimensionless
$RAF_{c\text{-}derm}$	OHM-specific	dimensionless
$RAF_{c\text{-}inh}$	OHM-specific	dimensionless
EF	0.714	event/day
$ED_{ing\ \&\ derm}$	1	day/event
ED_{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m^3/L
BW	58.0	kg
$AP_{(lifetime)}$	25,550	days
VR_{work}	60	L/min
AF	0.29	mg/cm^2
SA	3473	cm^2/day
$RCAF_{inh\text{-}gi}$	1.5	dimensionless
$RCAF_{inh}$	0.5	dimensionless
PM_{10}	60	$\mu g/m^3$

Construction Worker - Soil: Table CW-3
Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0808

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc\text{-}ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{dermal} = \frac{EPC * SA * AF * RAF_{nc\text{-}derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh\text{-}GI} = \frac{ADD_{inh\text{-}GI}}{RfD_{oral\text{-}subchronic}}$$

$$ADD_{inh\text{-}GI} = \frac{EPC * RCAF_{inh\ gi} * PM_{10} * VR_{work} * RAF_{nc\text{-}ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation\text{-}subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc\text{-}inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
$RAF_{nc\text{-}ing}$	OHM-specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM-specific	dimensionless
$RAF_{nc\text{-}inh}$	OHM-specific	dimensionless
EF	0.714	event/day
$EF_{cyanide}$	1	event/day
$ED_{ing\ \&\ derm}$	1	day/event
ED_{inh}	0.333	day/event
EP	182	days
$EP_{cyanide}$	1.00	day
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m^3/L
BW	58.0	kg
$AP_{noncancer}$	182	days
$AP_{cyanide}$	1	day
VR_{work}	60	L/min
AF	0.29	mg/cm^2
SA	3473	cm^2/day
$RCAF_{inh\text{-}gi}$	1.5	dimensionless
$RCAF_{inh}$	0.5	dimensionless
PM10	60	$\mu g/m^3$

Cyanide can cause a significant health risk from a one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Construction Worker - Soil: Table CW-4
Definitions and Exposure Factors

Vlookup Version v0808

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	µg/L	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF_{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
$EF_{cyanide}$ - Exposure Frequency for Cyanide Exposures	1.00	event/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$ED_{ing,derm}$ - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED_{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
$AP_{(lifetime)}$ - Averaging Period for lifetime	25,550	days	Represents 70 years
$AP_{(noncancer)}$ - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
AF - Adherence Factor	0.29	mg/cm^2	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR_{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm^2/day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
$RCAF_{inh\text{-}gi}$ - Relative Concentration Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
$RCAF_{inh}$ - Relative Concentration Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM_{10}	60	$\mu g/m^3$	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0808

Oil or Hazardous Material	Oral CSF $(mg/kg\text{-}day)^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	$RAF_{c\text{-}inh}$	Inhalation CSF $(mg/kg\text{-}day)^{-1}$	Subchronic Oral RfD mg/kg-day	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}inh}$	Subchronic Inhalation RfD
Benzene	5.5E-02	1	0.08	1	2.7E-02	1.0E-02	1	0.08	1	2.6E-02
Toluene						8.0E-01	1	0.12	1	1.4E+00
Ethylbenzene						1.0E+00	1	0.2	1	2.9E-01
Xylenes (mixed isomers)						2.0E-01	1	0.12	1	8.6E-02
Naphthalene						2.0E-01	0.36	0.1	1	8.6E-04
Aliphatics C5 to C8						4.0E-01	1	1	1	5.7E-02
Aliphatics C9 to C12						1.0E+00	1	0.5	1	1.7E-01
Aromatics C9 to C10						3.0E-01	1	0.5	1	1.4E-01
Aliphatics C9 to C18						1.0E+00	1	0.5	1	1.7E-01
Aliphaties C19 to C36						6.0E+00	1	0.1		
Aromaties C11 to C22						3.0E-01	0.36	0.1	1	1.4E-01
Methylnaphthalene, 2-						4.0E-03	0.36	0.1	1	1.4E-01
Phenanthrene						3.0E-01	0.36	0.1	1	1.4E-01
Acenaphthylene						3.0E-01	0.36	0.1	1	1.4E-01
Acenaphthene						6.0E-01	0.36	0.1	1	1.4E-01
Fluorene						4.0E-01	0.36	0.1	1	1.4E-01
Anthracene						3.0E+00	0.36	0.1	1	1.4E-01
Fluoranthene						4.0E-01	0.36	0.1	1	1.4E-01
Pyrene						3.0E-01	0.36	0.1	1	1.4E-01
Benzo(a)anthracene	7.3E-01	0.28	0.02	1	7.3E-01	3.0E-01	0.28	0.02	1	1.4E-01
Chrysene	7.3E-02	0.28	0.02	1	7.3E-02	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(b)fluoranthene	7.3E-01	0.28	0.02	1	7.3E-01	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(k)fluoranthene	7.3E-02	0.28	0.02	1	7.3E-02	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(a)pyrene	7.3E+00	0.28	0.02	1	7.3E+00	3.0E-01	0.28	0.02	1	1.4E-01
Indeno(1,2,3-cd)pyrene	7.3E-01	0.28	0.02	1	7.3E-01	3.0E-01	0.28	0.02	1	1.4E-01
Dibenzo(a,h)anthracene	7.3E+00	0.28	0.02	1	7.3E+00	3.0E-01	0.28	0.02	1	1.4E-01
Benzo(g,h,i)perylene						3.0E-01	0.36	0.1	1	1.4E-01

Table - RG-2: Risk Assessment - ADD and HI Calculations - Contact With Groundwater by Construction Workers (RTN 3-23606)

Contaminant of Concerns	Groundwater EPC	Dermal Relative Absorption Factor (RAF)	Skin Permeability Constant (Kp)	Exposure Duration (ED)	Exposure Frequency (EF)	Exposure Period (EP)	Averaging Period (AP)	Body Weight (BW)	Surface Area Exposed(SA)[1]	Conversion Constant (C)	Subchronic Average Daily Dose (ADD)	Oral Subchronic Reference Dose (RD)	Hazard Index (HI)
	µg/L		cm/hr	hr/day	2 days/7 days	year	year	Kg	cm^2		mg/(kg-day)	mg/(kg-day)	
VPH C5-C8 Aliphatics	25.0	1.0	1.66E-01	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	1.47388E-05	4.00E-01	3.68E-05
VPH C9-C12 Aliphatics	25.0	1.0	1.02E+00	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	9.05634E-05	1.00E+00	9.06E-05
VPH C9-C10 Aromatics	25.0	1.0	1.32E-01	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	1.17555E-05	3.00E-01	3.92E-05
Benzene	2.5	1.0	1.48E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	1.31051E-07	1.00E-02	1.31E-05
Toluene	2.5	1.0	3.07E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	2.72223E-07	8.00E-01	3.40E-07
Ethylbenzene	2.5	1.0	4.85E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	4.30265E-07	1.00E+00	4.30E-07
Xylenes	5.0	1.0	5.23E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	9.28542E-07	2.00E-01	4.64E-06
Naphtalene	5.0	1.1	4.58E-02	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	8.95406E-07	2.00E-01	4.48E-06
EPH C9-C18 Aliphatics	100.0	1.0	1.47E+00	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	5.23E-04	1.00E+00	5.23E-04
EPH C19-C36 Aliphatics	100.0	1.0	0.00E+00	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	0.00E+00	6.00E+00	0.00E+00
EPH C11-C22 Aromatics	75.0	1.1	5.24E-01	0.25	0.286	0.5	0.5	70	3,477	1.00E-06	1.54E-04	3.00E-01	5.12E-04
Total													1.22E-03

Notes

ADD = EPC × RAF × Kp × ED × EF × EP × SA × C/(BW × AP)

HI = ADD/RD

SA : Surface area of arms, hand feet, MDEP, 1995

ED : 15 minute exposure while setting up pump

EF : Twice per week

EP and AP : 6 month project duration (MDEP Shortform)

C : 0.001 mg/Kg × 0.001 L/cm^3 = 1.0E-06

Table - RG-4: Risk Assessment - LADD and ELCR Calculations - Contact With Groundwater by Construction Workers (RTN 3-23606)

Contaminant of Concerns	Groundwater EPC	Dermal Relative Absorption Factor (RAF)	Skin Permeability Constant (Kp)	Exposure Duration (ED)	Exposure Frequency (EF)	Exposure Period (EP)	Averaging Period (AP)	Body Weight (BW)	Surface Area Exposed(SA)[1]	Conversion Constant (C)	Lifetime Average Daily Dose (LADD)	Oral Cancer Slope Factor (CSF)	Excess Lifetime Cancer Risk (ELCR)
	µg/l		cm/hr	hr/day	2 days/7 days	year	year	Kg	cm^2		mg/(kg-day)	mg/(kg-day)	
VPH C5-C8 Aliphatics	25.0	1.0	1.66E-01	0.25	0.286	0.5	70	70	3,477	1.00E-06	1.05277E-07	NC	NC
VPH C9-C12 Aliphatics	25.0	1.0	1.02E+00	0.25	0.286	0.5	70	70	3,477	1.00E-06	6.46882E-07	NC	NC
VPH C9-C10 Aromatics	25.0	1.0	1.32E-01	0.25	0.286	0.5	70	70	3,477	1.00E-06	8.39678E-08	NC	NC
Benzene	2.5	1.0	1.48E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	9.36076E-10	5.50E-02	1.70E-08
Toluene	2.5	1.0	3.07E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	1.94445E-09	NC	NC
Ethylbenzene	2.5	1.0	4.85E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	3.07332E-09	NC	NC
Xylenes	5.0	1.0	5.23E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	6.63244E-09	NC	NC
Naphtalene	5.0	1.1	4.58E-02	0.25	0.286	0.5	70	70	3,477	1.00E-06	6.39576E-09	NC	NC
EPH C9-C18 Aliphatics	100.0	1.0	1.47E+00	0.25	0.286	0.5	70	70	3,477	1.00E-06	3.73923E-06	NC	NC
EPH C19-C36 Aliphatics	100.0	1.0	0.00E+00	0.25	0.286	0.5	70	70	3,477	1.00E-06	0	NC	NC
EPH C11-C22 Aromatics	75.0	1.1	5.24E-01	0.25	0.286	0.5	70	70	3,477	1.00E-06	1.09686E-06	NC	NC
Total													1.70E-08

Notes

LADD = EPC × RAF × Kp × ED × EF × EP × 5A × C/(BW × AP)

ELCR = LADD/CSF

NC : Not considered cancer causing

5A : Surface area of arms, hand feet, MDEP, 1995

ED : 15 minute exposure while setting up pump

EF : Twice per week

EP : 6 month project duration (MDEP Shortform)

AP : Lifetime of 70 years

C : 0.001 mg/Kg × 0.001 L/cm^3 = 1.0E-06

Method 3 Risk Assessment for a Trespasser Exposed to Chemicals in Soil - Shortform 2006 (sf06ts)

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EPCs	Table TS-1:	Select chemicals and enter Exposure Point Concentrations (EPCs). Associated risks are shown to the right.
C Eq	Table TS-2:	Equations to calculate cancer risks.
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Exp	Table TS-5:	Definitions and exposure factors.
Chem	Table TS-6:	Chemical-specific data.

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Trespasser - Soil: Table TS-1
Exposure Point Concentration (EPC)
Based on Trespasser Ages 11-18 (Cancer and Non-Cancer)

ShortForm Version 6-06

Vlookup Version v0808

ELCR (all chemicals) = 3E-08
Chronic HI (all chemicals) = 1E-03
Subchronic HI (all chemicals) = 3E-04

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	$ELCR_{ingestion}$	$ELCR_{dermal}$	$ELCR_{total}$	Chronic HQ_{ing}	Chronic HQ_{derm}	Chronic HQ_{total}	Subchronic HQ_{ing}	Subchronic HQ_{derm}	Subchronic HQ_{total}
Benzene	1.3E-01	1.2E-10	7.6E-11	1.9E-10	5.3E-06	3.5E-06	8.7E-06	4.6E-06	2.6E-06	7.2E-06
Toluene	5.1E-01				1.0E-06	1.0E-06	2.1E-06	2.3E-07	1.9E-07	4.1E-07
Ethylbenzene	2.8E-01				4.6E-07	7.6E-07	1.2E-06	1.0E-07	1.4E-07	2.4E-07
Xylenes (mixed isomers)	2.0E+00				1.6E-06	1.6E-06	3.3E-06	3.6E-06	3.0E-06	6.6E-06
Naphthalene	1.2E+00				3.5E-06	8.0E-06	1.2E-05	7.7E-07	1.5E-06	2.2E-06
Aliphatics C5 to C8	2.0E+01				8.1E-05	6.7E-04	7.5E-04	1.8E-05	1.2E-04	1.4E-04
Aliphatics C9 to C12	1.4E+01				2.3E-05	9.3E-05	1.2E-04	5.0E-06	1.7E-05	2.2E-05
Aromatics C9 to C10	1.1E+01				5.9E-05	2.4E-04	3.0E-04	1.3E-05	4.5E-05	5.8E-05
Aliphatics C9 to C18	5.4E+00				8.7E-06	3.6E-05	4.5E-05	1.9E-06	6.6E-06	8.5E-06
Aliphatics C19 to C36	9.6E+00				7.8E-07	6.4E-07	1.4E-06	5.7E-07	3.9E-07	9.6E-07
Aromatics C11 to C22	1.3E+01				2.5E-05	5.8E-05	8.3E-05	5.5E-06	1.1E-05	1.6E-05
Methylnaphthalene, 2-	2.4E-01				3.5E-06	8.0E-06	1.2E-05	7.7E-06	1.5E-05	2.2E-05
Phenanthrene	3.1E-01				6.0E-07	1.4E-06	2.0E-06	1.3E-07	2.5E-07	3.9E-07
Acenaphthylene	2.5E-01				4.9E-07	1.1E-06	1.6E-06	1.1E-07	2.0E-07	3.1E-07
Acenaphthene	2.4E-01				2.3E-07	5.3E-07	7.7E-07	5.1E-08	9.8E-08	1.5E-07
Fluorene	2.4E-01				3.5E-07	8.0E-07	1.2E-06	7.7E-08	1.5E-07	2.2E-07
Anthracene	2.4E-01				4.7E-08	1.1E-07	1.5E-07	1.0E-08	2.0E-08	3.0E-08
Fluoranthene	3.6E-01				5.2E-07	1.2E-06	1.7E-06	1.1E-07	2.2E-07	3.4E-07
Pyrene	3.5E-01				6.8E-07	1.6E-06	2.2E-06	1.5E-07	2.9E-07	4.4E-07
Benzo(a)anthracene	2.7E-01	8.9E-10	5.3E-10	1.4E-09	4.1E-07	2.4E-07	6.5E-07	8.9E-08	4.4E-08	1.3E-07
Chrysene	3.0E-01	9.9E-11	5.8E-11	1.6E-10	4.5E-07	2.7E-07	7.2E-07	9.9E-08	4.9E-08	1.5E-07
Benzo(b)fluoranthene	2.8E-01	9.3E-10	5.5E-10	1.5E-09	4.2E-07	2.5E-07	6.7E-07	9.3E-08	4.6E-08	1.4E-07
Benzo(k)fluoranthene	2.7E-01	8.9E-11	5.3E-11	1.4E-10	4.1E-07	2.4E-07	6.5E-07	8.9E-08	4.4E-08	1.3E-07
Benzo(a)pyrene	2.8E-01	9.3E-09	5.5E-09	1.5E-08	4.2E-07	2.5E-07	6.7E-07	9.3E-08	4.6E-08	1.4E-07
Indeno(1,2,3-cd)pyrene	2.7E-01	8.9E-10	5.3E-10	1.4E-09	4.1E-07	2.4E-07	6.5E-07	8.9E-08	4.4E-08	1.3E-07
Dibenzo(a,h)anthracene	2.5E-01	8.3E-09	4.9E-09	1.3E-08	3.8E-07	2.2E-07	6.0E-07	8.3E-08	4.1E-08	1.2E-07
Benzo(g,h,i)perylene	4.2E-01				8.2E-07	1.9E-06	2.7E-06	1.8E-07	3.4E-07	5.2E-07

Trespasser - Soil: Table TS-2
Equations to Calculate Cancer Risk for a Trespasser (Age 11-18 years)

Vlookup Version v0808

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF$$

$$LADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{c\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF$$

$$LADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{c\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM specific	$(mg/kg\text{-}day)^{-1}$
LADD	age/OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{c\text{-}ing}$	OHM specific	dimensionless
$RAF_{c\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.164	event/day
ED	1	day/event
EP	7	years
C	0.000001	kg/mg
BW	50.7	kg
$AP_{(lifetime)}$	70	years
SA	2940	cm^2 / day
SAF	0.14	mg/cm^2

Trespasser - Soil: Table TS-3
Equations to Calculate Chronic Noncancer Risk for a Trespasser (Age 11-18 years)

Vlookup Version v0808

Chronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Chronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{ing,derm}}{RfD}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.164	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
EP	7	years
$EP_{cyanide}$	1	day
C	0.000001	kg/mg
BW	50.7	kg
AP	7	year
$AP_{cyanide}$	1	day
SA	2940	cm^2 / day
SAF	0.14	mg/cm^2

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Trespasser - Soil: Table TS-4
Equations to Calculate Subchronic Noncancer Risk for a Trespasser (Age 11-12 years)

Vlookup Version v0808

Subchronic Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{subchronic}}$$

$$ADD_{ing} = \frac{[OHM]_{soil} * IR * RAF_{nc\text{-}ing} * EF_{ing} * ED * EP * C}{BW * AP}$$

Subchronic Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{subchronic}}$$

$$ADD_{derm} = \frac{[OHM]_{soil} * SA * RAF_{nc\text{-}derm} * SAF * EF_{derm} * ED * EP * C}{BW * AP}$$

Parameter	Value	Units
RfD	OHM specific	mg/kg-day
ADD	OHM specific	mg/kg-day
$[OHM]_{soil}$	OHM specific	mg/kg
IR	50	mg/day
$RAF_{nc\text{-}ing}$	OHM specific	dimensionless
$RAF_{nc\text{-}derm}$	OHM specific	dimensionless
$EF_{ing,derm}$	0.286	event/day
$EF_{cyanide}$	1.00	event/day
ED	1	day/event
$EP_{cyanide}$	1	day
EP	0.577	years
C	0.000001	kg/mg
BW	40.3	kg
AP	0.577	year
$AP_{cyanide}$	1	day
SA	2477	cm^2 / day
SAF	0.14	mg/cm^2

Cyanide can cause a significant health risk from one-time exposure to concentrations that are often found in the environment. As such, risk is calculated for a single exposure. Thus, for cyanide, the exposure frequency (EF) is 1 event/day, while both the exposure period (EP) and averaging period (AP) are 1 day.

Trespasser - Soil: Table TS-5
Definitions and Exposure Factors

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Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	$(mg/kg\text{-}day)^{-1}$	see Table RS-7
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
HQ - Hazard Quotient	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
RfD - Reference Dose	chemical specific	mg/kg-day	see Table RS-7
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific
EPC - Exposure Point Concentration	chemical specific	mg/kg	
IR - Soil Ingestion Rate	50	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm)
RAF_c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	
$EF_{subchronic}$ - Exposure Frequency for subchronic ingestion or dermal exposure	0.286	event/day	2 days/week
$EF_{chronic}$ - Exposure Frequency for chronic ingestion or dermal exposure	0.164	event/day	2 days/week, 30 weeks/year
EF_{cancer} - Exposure Frequency for cancer, ingestion or dermal exposure	0.164	event/day	2 days/week, 30 weeks/year
$EF_{cyanide}$ - Exposure Frequency for cyanide exposure	1.00	event/day	
ED - Exposure Duration	1	day/event	
$EP_{(11\text{-}12)}$ - Exposure Period for age group 11-12	0.577	years	30 weeks
$EP_{(11\text{-}18)}$ - Exposure Period for age group 11-18	7	years	
$EP_{cyanide}$ - Exposure period for cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$BW_{(11\text{-}12)}$ - Body Weight for age group 11-12	40.3	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7
$BW_{(11\text{-}18)}$ - Body Weight for age group 11-18	50.7	kg	Ibid
$AP_{subchronic}$ - Averaging Period for subchronic noncancer	0.577	years	30 weeks
$AP_{chronic}$ - Averaging Period for chronic noncancer	7	years	
AP_{cancer} - Averaging Period for lifetime	70	years	
$AP_{cyanide}$ - Averaging period for assessing cyanide exposure	1	day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. Page 5-5.
$SA_{(11\text{-}12)}$ - Surface Area for age group 11-12	2477	cm^2 / day	50th percentile of forearms, hands, and feet for females. MADEP 1995 Guidance for Disposal Site Risk Characterization, Table B-2.
$SA_{(11\text{-}18)}$ - Surface Area for age group 11-18	2940	cm^2 / day	Ibid
SAF - Surface Adherence Factor, Trespasser	0.14	mg/cm^2	SAF developed for ShortForm according to procedure outlined in MA DEP Technical Update: Weighted Skin-Soil Adherence Factors, April 2002.

Trespasser - Soil: Table TS-6
Chemical-Specific Data

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Oil or Hazardous Material	CSF $(mg/kg\text{-}day)^{-1}$	$RAF_{c\text{-}ing}$	$RAF_{c\text{-}derm}$	Chronic RfD mg/kg-day	Subchronic RfD mg/kg-day	Chronic $RAF_{nc\text{-}ing}$	Chronic $RAF_{nc\text{-}derm}$	Subchronic $RAF_{nc\text{-}ing}$	Subchronic $RAF_{nc\text{-}derm}$
Benzene	5.5E-02	1.00	0.08	4.0E-03	1.0E-02	1	0.08	1	0.08
Toluene				8.0E-02	8.0E-01	1	0.12	1	0.12
Ethylbenzene				1.0E-01	1.0E+00	1	0.2	1	0.2
Xylenes (mixed isomers)				2.0E-01	2.0E-01	1	0.12	1	0.12
Naphthalene				2.0E-02	2.0E-01	0.36	0.1	0.36	0.1
Aliphatics C5 to C8				4.0E-02	4.0E-01	1	1	1	1
Aliphatics C9 to C12				1.0E-01	1.0E+00	1	0.5	1	0.5
Aromatics C9 to C10				3.0E-02	3.0E-01	1	0.5	1	0.5
Aliphatics C9 to C18				1.0E-01	1.0E+00	1	0.5	1	0.5
Aliphatics C19 to C36				2.0E+00	6.0E+00	1	0.1	1	0.1
Aromatics C11 to C22				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Methylnaphthalene, 2-				4.0E-03	4.0E-03	0.36	0.1	0.36	0.1
Phenanthrene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Acenaphthylene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Acenaphthene				6.0E-02	6.0E-01	0.36	0.1	0.36	0.1
Fluorene				4.0E-02	4.0E-01	0.36	0.1	0.36	0.1
Anthracene				3.0E-01	3.0E+00	0.36	0.1	0.36	0.1
Fluoranthene				4.0E-02	4.0E-01	0.36	0.1	0.36	0.1
Pyrene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1
Benzo(a)anthracene	7.3E-01	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Chrysene	7.3E-02	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(b)fluoranthene	7.3E-01	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(k)fluoranthene	7.3E-02	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(a)pyrene	7.3E+00	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Indeno(1,2,3-cd)pyrene	7.3E-01	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Dibenzo(a,h)anthracene	7.3E+00	0.28	0.02	3.0E-02	3.0E-01	0.28	0.02	0.28	0.02
Benzo(g,h,i)perylene				3.0E-02	3.0E-01	0.36	0.1	0.36	0.1

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		CHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE)		SUBCHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE)		Chronic Inhalation Reference Concentration (or substitute)		Subchronic Inhalation Reference Concentration (or substitute)		Oral Cancer Slope Factor			Inhalation Unit Risk		SUBCHRONIC INHALATION REFERENCE DOSE (OR SUBSTITUTE)		Inhalation Cancer Slope Factor	
OIL OR HAZARDOUS MATERIAL	CAS	mg/kg/day	REF	mg/kg/day	REF	mg/m3	REF	mg/m3	REF	(mg/kg/day)$^{-1}$	CLASS	REF	(µg/m3)$^{-1}$	REF	mg/kg/day	REF	(mg/kg/day)$^{-1}$	REF
Acenaphthene	83-32-9	6 0E-02	1	6 0E-01	2	5 0E-02	44	5 0E-01	44						1 4E-01	45		46
Acenaphthylene	208-96-8	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44		D	1			1 4E-01	45		46
Acetone	67-64-1	9 0E-01	1	2 7E+00	1i	8 0E-01	3	8 0E-01	40		D	1			2 3E-01	45		46
Aldrin	309-00-2	3 0E-05	1	3 0E-05	2	1 1E-04		1 1E-04	40	1 7E+01	B2	1	4 90E-03	1	3 0E-05	45	1 7E+01	46
Anthracene	120-12-7	3 0E-01	1	3 0E+00	2	5 0E-02	44	5 0E-01	44		D	1			1 4E-01	45		46
Antimony	7440-36-0	4 0E-04	1	4 0E-04	2	1 0E-02	3	1 0E-02	40						2 9E-03	45		46
Arsenic	7440-38-2	3 0E-04	1	3 0E-04	2	2 5E-06	3	2 5E-06	40	1 5E+00	A	1	4 30E-03	1	7 1E-07	45	1 5E+01	46
Barium	7440-39-3	2 0E-01	1	7 00E-02	2	5 0E-04	2e	5 0E-03	2b						1 4E-03	45		46
Benzene	71-43-2	4 0E-03	1	1 0E-02	1i	3 0E-02	1	9 0E-02	1k	5 5E-02	A	1	7 80E-06	1	2 6E-02	45	2 7E-02	46
Benzo(a)anthracene	56-55-3	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-01	B2	1e	2 09E-04	35	1 4E-01	45	7 3E-01	46
Benzo(a)pyrene	50-32-8	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E+00	B2	1	2 09E-03	35	1 4E-01	45	7 3E+00	46
Benzo(b)fluoranthene	205-99-2	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-01	B2	1e	2 09E-04	35	1 4E-01	45	7 3E-01	46
Benzo(g,h,i)perylene	191-24-2	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44						1 4E-01	45		46
Benzo(k)fluoranthene	207-08-9	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-02	B2	1a	2 09E-05	35	1 4E-01	45	7 3E-02	46
Beryllium	7440-41-7	2 0E-03	1	5 0E-03	2	2 0E-05	1	2 0E-05	1j		B1	1f	2 40E-03	1	5 7E-06	45	8 4E+00	46
Biphenyl, 1,1-	92-52-4	5 0E-02	1	5 0E-02	2	2 0E-03	3	2 0E-03	40		D	1			5 7E-04	45		46
Bis(2-chloroethyl)ether	111-44-4									1 1E+00	B2	1	3 30E-04	1		45	1 2E+00	46
Bis(2-chloroisopropyl)ether	39638-32-9	4 0E-02	1	4 0E-02	1d	1 4E-01	39	1 4E-01	40	7 0E-02	C	2d	1 00E-05	2	4 0E-02	45	3 5E-02	46
Bis(2-ethylhexyl)phthalate	117-81-7	2 0E-02	1	2 0E-02	2d	7 0E-03	3	7 0E-03	40	1 4E-02	B2	1	1 30E-06	3	2 0E-03	45	4 6E-03	46
Bromodichloromethane	75-27-4	2 0E-02	1	2 0E-02	2	7 0E-02	39	7 0E-02	40	8 2E-02	B2	1	1 77E-05	35	2 0E-02	45	6 2E-02	46
Bromoform	75-25-2	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k	7 9E-03	B2	1	1 10E-06	1	2 0E-01	45	3 9E-03	46
Bromomethane	74-83-9	1 4E-03	1	1 4E-02	2d	5 0E-03	1	5 0E-02	1k		D	1			1 4E-02	45		46
Cadmium	7440-43-9	5 0E-04	1c	5 0E-04	1d	2 0E-05	3	2 0E-05	40		B1	1	1 80E-03	1	5 7E-06	45	8 3E+00	46
Carbon tetrachloride	56-23-5	7 0E-04	1	7 0E-03	2d	4 3E-01	3	4 3E-01	40	1 3E-01	B2	1	1 50E-05	1	1 2E-01	45	5 3E-02	46
Chlordane	12789-03-6	5 0E-04	1	5 0E-04	1d	7 0E-04	1	7 0E-03	1k	3 5E-01	B2	1	1 00E-04	1	2 0E-03	45	3 5E-01	46
Chloroaniline, p-	106-47-8	4 0E-03	1	4 0E-03	2	1 4E-02	39	1 4E-02	40						4 0E-03	45		46
Chlorobenzene	108-90-7	2 0E-02	1	2 0E-01	2d	2 0E-02	2e	2 0E-02	40		D	1			5 7E-03	45		46
Chloroform	67-66-3	1 0E-02	1	1 0E-02	2	8 8E-01	3	8 6E-01	40		B2	1	2 30E-05	1	1 9E-01	45	8 1E-02	46
Chlorophenol, 2-	95-57-8	5 0E-03	1	5 0E-02	2	1 8E-02	39	1 8E-01	1k						5 1E-02	45		46
Chromium (total)	7440-47-3	3 0E-03		2 0E-02		1 0E-04		3 0E-04					1 20E-02		6 8E-05	45	4 2E+01	46
Chromium(III)	16065-83-1	1 5E+00	1	1 5E+00	1d	1 0E-04	1h	3 0E-04	1k						6 8E-05	45		46
Chromium(VI)	18540-29-9	3 0E-03	1	2 0E-02	2	1 0E-04	1	3 0E-04	1k				1 20E-02	1	6 8E-05	45	4 2E+01	46
Chrysene	218-01-9	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E-02	B2	1e	2 09E-05	35	1 4E-01	45	7 3E-02	46
Cyanide	57-12-5	1 0E-02	4a	1 0E-02	4a	7 0E-03	4	7 0E-03	40		D	1			2 0E-03	45		46
Dibenzo(a,h)anthracene	53-70-3	3 0E-02	44	3 0E-01	44	5 0E-02	44	5 0E-01	44	7 3E+00	B2	1e	2 09E-03	35	1 4E-01	45	7 3E+00	46
Dibromochloromethane	124-48-1	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k	8 4E-02	C	1	2 40E-05	35	2 0E-01	45	8 4E-02	46
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	9 0E-02	1	9 0E-01	2d	2 0E-01	2e	2 0E-01	40		D	1			5 7E-02	45		46
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	9 0E-02	1b	9 0E-01	2a	2 0E-01	2f	2 0E-01	40		D	1			5 7E-02	45		46
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	9 0E-02	1b	9 0E-01	2a	8 0E-01	1	2 4E+00	1k	2 4E-02	C	2	8 86E-06	35	8 9E-01	45	2 4E-02	46
Dichlorobenzidine, 3,3'-	91-94-1									4 5E-01	B2	1	1 29E-04	35		45	4 5E-01	46
DDD	72-54-8	5 0E-04	1g	5 0E-04	2g	1 8E-03	39	1 8E-03	40	2 4E-01	B2	1	8 86E-05	35	5 0E-04	45	2 4E-01	46
DDE	72-55-9	5 0E-04	1g	5 0E-04	2g	1 8E-03	39	1 8E-03	40	3 4E-01	B2	1	9 71E-05	35	5 0E-04	45	3 4E-01	46
DDT	50-29-3	5 0E-04	1	5 0E-04	2	1 8E-03	39	1 8E-03	40	3 4E-01	B2	1	9 70E-05	1	5 0E-04	45	3 4E-01	46
Dichloroethane, 1,1-	75-34-3	1 0E-01	2	1 0E+00	2	5 0E-01	2e	5 0E+00	2b		C	1		35	1 4E+00	45		46
Dichloroethane, 1,2-	107-06-2	2 0E-02	4	2 0E-01	4	5 5E-02	3	5 5E-02	40	9 1E-02	B2	1	2 60E-05	1	1 8E-02	45	9 1E-02	46
Dichloroethylene, 1,1-	75-35-4	5 0E-02	1	5 0E-02	1d	2 0E-01	1	2 0E-01	1j		C	1		1	5 7E-02	45		46
Dichloroethylene, cis-1,2-	156-59-2	1 0E-02	2	1 0E-01	2	3 5E-02	39	3 5E-02	40		D	1			1 0E-02	45		46
Dichloroethylene, trans-1,2-	156-60-5	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k						2 0E-01	45		46
Dichloromethane	75-09-2	6 0E-02	1	6 0E-02	2	3 0E+00	2	3 0E+00	40	7 5E-03	B2	1	4 70E-07	1	6 8E-01	45	1 6E-03	46
Dichlorophenol, 2,4-	120-83-2	3 0E-03	1	3 0E-03	2	1 1E-02	39	1 1E-02	40						3 0E-03	45		46
Dichloropropane, 1,2-	78-87-5					4 0E-03	1	1 2E-02	1k	6 8E-02	B2	2	1 90E-05	3	3 4E-03	45	6 7E-02	46
Dichloropropene, 1,3-	542-75-6	3 0E-02	1	3 0E-02	1d	2 0E-02	1	2 0E-02	1j	1 0E-01	B2	1	4 00E-06	1	5 7E-03	45	1 4E-02	46
Dieldrin	60-57-1	5 0E-05	1	5 0E-05	2	1 8E-04	39	1 8E-04	40	1 6E+01	B2	1	4 60E-03	1	5 0E-05	45	1 6E+01	46
Diethyl phthalate	84-66-2	8 0E-01	1	8 0E+00	2	2 8E+00	39	2 8E+01	1k		D	1			8 0E+00	45		46
Dimethyl phthalate	131-11-3	1 0E+01	2d	1 0E+01	2d	3 5E+01	39	3 5E+01	40		D	1			1 0E+01	45		46
Dimethylphenol, 2,4-	105-67-9	2 0E-02	1	2 0E-01	2	7 0E-02	39	7 0E-01	1k						2 0E-01	45		46
Dinitrophenol, 2,4-	51-28-5	2 0E-03	1	2 0E-03	2	7 0E-03	39	7 0E-02	1k						2 0E-02	45		46
Dinitrotoluene, 2,4-	121-14-2	2 0E-03	1	2 0E-03	2	7 0E-03	39	7 0E-03	40	6 8E-01	B2	1a	1 94E-04	35	2 0E-03	45	6 8E-01	46
Dioxane, 1,4-	123-91-1	1 0E-02	5	1 0E-01	5	1 2E-01	2	1 2E-01	40	1 1E-02	B2	1	4 10E-06	3	3 4E-02	45	1 4E-02	46
Endosulfan	115-29-7	6 0E-03	1	6 0E-03	2	2 1E-02	39	2 1E-02	40						6 0E-03	45		46
Endrin	72-20-8	3 0E-04	1	3 0E-04	2	1 1E-03	39	1 1E-03	40		D	1			3 0E-04	45		46
Ethylbenzene	100-41-4	1 0E-01	1	1 0E+00	2d	1 0E+00	1	1 0E+00	1j		D	1			2 9E-01	45		46
Ethylene dibromide	106-93-4	9 0E-03	1	9 0E-03	1d	9 0E-03	1	9 0E-03	40	2 0E+00	B2	1	3 00E-04	1	2 6E-03	45	1 1E+00	46
Fluoranthene	206-44-0	4 0E-02	1	4 0E-01	2	5 0E-02	44	5 0E-01	44		D	1			1 4E-01	45		46
Fluorene	86-73-7	4 0E-02	1	4 0E-01	2	5 0E-02	44	5 0E-01	44						1 4E-01	45		46

Vlookup Version v0808				SUBCHRONIC		Chronic		Subchronic							SUBCHRONIC			
OIL OR HAZARDOUS MATERIAL	CAS	CHRONIC ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	ORAL REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Inhalation Reference Concentration (or substitute) mg/m3	REF	Inhalation Reference Concentration (or substitute) mg/m3	REF	Oral Cancer Slope Factor $(mg/kg/day)^{-1}$	CLASS	REF	Inhalation Unit Risk $(\mu g/m3)^{-1}$	REF	INHALATION REFERENCE DOSE (OR SUBSTITUTE) mg/kg/day	REF	Inhalation Cancer Slope Factor $(mg/kg/day)^{-1}$	REF
Heptachlor	76-44-B	5 0E-04	1	5.0E-04	2	1.0E-03	3	1.0E-03	40	4.5E+00	B2	1	1.30E-03	1	2.9E-04	45	4.6E+00	46
Heptachlor epoxide	1024-57-3	1.3E-05	1	1.3E-05	2	4.6E-05	39	4 6E-05	40	9.1E+00	B2	1	2.60E-03	1	1.3E-05	45	9.1E+00	46
Hexachlorobenzene	11B-74-1	6 0E-04	1	6.0E-04	2d	2.6E-03	39	2.6E-03	40	1.6E+00	B2	1	4.60E-04	1	8.0E-04	45	1.6E+00	46
Hexachlorobutadiene	87-68-3	2 0E-04	2	2.0E-03	2d	7.0E-04	39	7.0E-04	40	7.6E-02	C	1	2.20E-05	1	2.0E-04	45	7 7E-02	46
gamma-HCH	58-89-9	3.0E-04	1	3.0E-03	2	1.1E-03	39	1.1E-02	1k	1.3E+00	B2-C	2	3.71E-04	35	3.1E-03	45	1.3E+00	46
Hexachloroethane	67-72-1	1.0E-03	1	1.0E-02	2	3.0E-03	3	3.0E-03	40	1.4E-02	C	1	4.00E-06	1	8.6E-04	45	1.4E-02	46
Hmx	2691-41-0	5.0E-02	1	5.0E-02	1d	1.6E-01	39	1 6E-01	40		D	1			5.0E-02	45		46
Indeno(1,2,3-cd)pyrene	193-39-5	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44	7.3E-01	B2	1e	2.09E-04	35	1.4E-01	45	7.3E-01	46
Lead	7439-92-1	7.5E-04	4	7.5E-04	4	1.0E-03	3	1.0E-03	40		B2	1			2.9E-04	45		46
Mercury	7439-97-6	3.0E-04	2d	3 0E-04	2d	3.0E-04	1	3.0E-04	1j		D	1			8.6E-05	45		46
Methoxychlor	72-43-5	5.0E-03	1	5.0E-03	2	1.6E-02	39	1.6E-02	40		D	1			5.0E-03	45		46
Methyl ethyl ketone	78-93-3	6.0E-01	1	6.0E-01	1d	5.0E+00	1	5.0E+00	1j		D	1			1.4E+00	45		46
Methyl isobutyl ketone	108-10-1	6.0E-02	2	8.0E-01	2	3.0E+00	2l.	3.0E+00	40						8.6E-01	45		46
Methyl mercury	22967-92-6	1.0E-04	1	1.0E-04	2	2.0E-05	3	2.0E-05	40		C	1			5.7E-06	45		46
Methyl tert butyl ether	1634-04-4	1.0E-01	5	1.0E+00	5	3.0E+00	1	3.0E+00	40		C				8.6E-01	45		46
Methylnaphthalene, 2-	91-57-6	4.0E-03	1	4.0E-03	1j	5.0E-02	44	5.0E-01	44						1.4E-01	45		46
Naphthalene	91-20-3	2.0E-02	1	2.0E-01	1i	3.0E-03	1	3.0E-03	40						8.6E-04	45		46
Nickel	7440-02-0	2.0E-02	1	2.0E-02	2	1.0E-03	3	1.0E-03	40		A	1	4.80E-04	1	2.9E-04	45	1.7E+00	46
N-nitrosodimethylamine (NDMA)	62-75-9									5.1E+01	B2	1	1.40E-02	1		45	4.9E+01	46
Pentachlorophenol	87-B6-5	3.0E-02	1	3.0E-02	2	7.0E-05	3	7.0E-05	40	1.2E-01	B2	1	3.43E-05	35	2.0E-05	45	1.2E-01	46
Perchlorate	NA	3.0E-05	41	9.0E-05	41	1.1E-04	39	1.1E-04	40						3.0E-05	45		46
Petroleum hydrocarbons	NA															45		46
Aliphatics C5 to C8	NA	4 0E-02	31a	4.0E-01	31	2.0E-01	31	2.0E-01	40						5.7E-02	45		46
Aliphatics C9 to C12	NA	1.0E-01	31a	1.0E+00	31	2.0E-01	31	6.0E-01	40						1 7E-01	45		46
Aliphatics C9 to C18	NA	1.0E-01	31a	1.0E+00	31	2.0E-01	31	6.0E-01	40						1.7E-01	45		46
Aliphatics C19 to C36	NA	2.0E+00	31a	6.0E+00	31		31									45		46
Aromatics C9 to C10	NA	3.0E-02	31a	3.0E-01	31	5.0E-02	31	5.0E-01	40						1.4E-01	45		46
Aromatics C11 to C22	NA	3 0E-02	31a	3.0E-01	31	5.0E-02	31	5.0E-01	40						1.4E-01	45		46
Phenanthrene	85-01-B	3.0E-02	44	3.0E-01	44	5.0E-02	44	5.0E-01	44		D	1			1 4E-01	45		46
Phenol	108-95-2	3.0E-01	1	3.0E-01	1d	2.6E-01	3	2 6E-01	40		D	1			7.4E-02	45		46
Polychlorinated biphenyls (PCBs)	1336-36-3	2.0E-05	1	5.0E-05	2	2.0E-05	3	2.0E-05	40	2.0E+00	B2	1	1.00E-04	1	5.7E-06	45	3.5E-01	46
Pyrene	129-00-0	3.0E-02	1	3.0E-01	2	5.0E-02	44	5.0E-01	44		D	1			1.4E-01	45		46
Rdx	121-82-4	3.0E-03	1	3.0E-03	1i	1.1E-02	39	1.1E-02	40	1.1E-01	C	1	3 14E-05	35	3.0E-03	45	1.1E-01	46
Selenium	7782-49-2	5.0E-03	1	5.0E-03	2	3.0E-03	3	3.0E-03	40		D	1			8.6E-04	45		48
Silver	7440-22-4	5.0E-03	1	5.0E-03	2	1 4E-04	5	1 4E-04	40		D	1			4.0E-05	45		46
Styrene	100-42-5	2.0E-01	1	2.0E+00	2d	1.0E+00	1	3.0E+00	1k	3.0E-02	B2	2d	5.70E-07	2d	6.6E-01	45	2.0E-03	46
TCDD, 2,3,7,8- (equivalents)	1746-01-6									1.5E+05	B2	2	3.30E+01	2		45	1.2E+05	46
Tetrachloroethane, 1,1,1,2-	630-20-6	3.0E-02	1	3.0E-02	2	1.1E-01	39	1 1E-01	40	2.6E-02	C	1	7.40E-06	1	3.0E-02	45	2.6E-02	46
Tetrachloroethane, 1,1,2,2-	79-34-5					9.3E-02	3	9 3E-02	40	2.0E-01	C	1	5.80E-05	1	2.7E-02	45	2.0E-01	48
Tetrachloroethylene	127-1B-4	1.0E-02	1	1.0E-01	2	4.6E+00	3	4.6E+00	40	5.1E-02	C-B2	2c	1.00E-05	5	1.3E+00	45	3.5E-02	48
Thallium	7440-2B-0	6 0E-05	1	8.0E-04	1i	1.4E-05	5	1 4E-05	40						4.0E-06	45		46
Toluene	108-88-3	8.0E-02	1	6.0E-01	1l	5.0E+00	1	5.0E+00	40		D	1			1.4E+00	45		46
Trichlorobenzene, 1,2,4-	120-82-1	1.0E-02	1	1.0E-02	2	2.0E-01	2	2 0E+00	2b		D	1			5.7E-01	45		46
Trichloroethane, 1,1,1-	71-55-6	9 0E-02	2d	9.0E-01	2d	5.2E+00	3	5.2E+00	40		D	1			1.5E+00	45		46
Trichloroethane, 1,1,2-	79-00-5	4.0E-03	1	4.0E-02	2	7 4E-02	3	7 4E-02	40	5.7E-02	C	1	1 60E-05	1	2.1E-02	45	5.6E-02	46
Trichloroethylene	79-01-6	2.0E-03	4	2.0E-02	4	1.8E-01	3	1.6E-01	40	1 1E-02	C-B2	2c	1.70E-06	2d	5.1E-02	45	6.0E-03	48
Trichlorophenol, 2,4,5-	95-95-4	1.0E-01	1	1.0E+00	2	3.5E-01	39	3.5E+00	1k						1.0E+00	45		46
Trichlorophenol 2,4,6-	88-06-2									1.1E-02	B2	1	3.10E-06	1		45	1.1E-02	46
Vanadium	7440-62-2	9 0E-03	1	9 0E-03	1d	1.0E-03	3	1.0E-03	40						2.9E-04	45		46
Vinyl chloride	75-01-4	3 0E-03	1	3 0E-03	1d	1.0E-01	1	1 0E-01	40	1.4E+00	A	1	8.80E-06	1	2.9E-02	45	3.1E-02	46
Xylenes (mixed isomers)	1330-20-7	2.0E-01	1	2.0E-01	1d	1.0E-01	3	3 0E-01	1k		D	1			8 6E-02	45		46
Zinc	7440-66-6	3.0E-01	1	3.0E-01	2	1.4E-03	5	1.4E-03	40		D	1			4.0E-04	45		46

OIL OR HAZARDOUS MATERIAL	CAS	Relative Absorption Factors (RAFs)							
		Soil						Air[1]	
		Chronic Ingestion	Chronic Dermal	Subchronic Ingestion	Subchronic Dermal	Cancer Ingestion	Cancer Dermal	Subchronic Inhalation	Cancer Inhalation
Acenaphthene	83-32-9	0.36	0.1	0.36	0.1	NC	NC	1	
Acenaphthylene	208-96-8	0.36	0.1	0.36	0.1	NC	NC	1	
Acetone	67-64-1	1	0.1	1	0.1	NC	NC	1	
Aldrin	309-00-2	1	0.25	1	0.25	1	0.25	1	1
Anthracene	120-12-7	0.36	0.1	0.36	0.1	NC	NC	1	
Antimony	7440-36-0	1	0.1	1	0.1	NC	NC	1	
Arsenic	7440-38-2	1	0.03	1	0.03	1	0.03	1	1
Barium	7440-39-3	1	0.05	1	0.05	NC	NC	1	
Benzene	71-43-2	1	0.08	1	0.08	1	0.08	1	1
Benzo(a)anthracene	56-55-3	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(a)pyrene	50-32-8	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(b)fluoranthene	205-99-2	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Benzo(g,h,i)perylene	191-24-2	0.36	0.1	0.36	0.1	NC	NC	1	
Benzo(k)fluoranthene	207-08-9	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Beryllium	7440-41-7	1	0.03	1	0.03	1	0.03	1	1
Biphenyl, 1,1-	92-52-4	1	0.08	1	0.08	NC	NC	1	
Bis(2-chloroethyl)ether	111-44-4	NC	NC	NC	NC	1	1		1
Bis(2-chloroisopropyl)ether	39638-32-9	1	1	1	1	1	1	1	1
Bis(2-ethylhexyl)phthalate	117-81-7	1	0.02	1	0.02	1	0.02	1	1
Bromodichloromethane	75-27-4	1	0.1	1	0.1	1	0.1	1	1
Bromoform	75-25-2	1	0.11	1	0.11	1	0.1	1	1
Bromomethane	74-83-9	1	0.1	1	0.1	NC	NC	1	
Cadmium	7440-43-9	1	0.14	1	0.14	NC	NC	1	1
Carbon tetrachloride	56-23-5	1	0.1	1	0.1	1	0.1	1	1
Chlordane	12789-03-6	1	0.05	1	0.05	1	0.05	1	1
Chloroaniline, p-	106-47-8	1	0.1	1	0.1	NC	NC	1	
Chlorobenzene	108-90-7	1	0.1	1	0.1	NC	NC	1	
Chloroform	67-66-3	1	0.1	1	0.1			1	1
Chlorophenol, 2-	95-57-8	1	0.26	1	0.26	NC	NC	1	
Chromium (total)	7440-47-3	1	0.09	1	0.09	NC	NC	1	1
Chromium(III)	16065-83-1	1	0.04	1	0.04	NC	NC	1	
Chromium(VI)	18540-29-9	1	0.09	1	0.09	NC	NC	1	1
Chrysene	218-01-9	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Cyanide	57-12-5	1	0.3	1	0.3	NC	NC	1	
Dibenzo(a,h)anthracene	53-70-3	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Dibromochloromethane	124-48-1	1	0.1	1	0.1	1	0.1	1	1
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	1	0.1	1	0.1	NC	NC	1	
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	1	0.1	1	0.1	NC	NC	1	
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	1	0.1	1	0.1	1	0.1	1	1
Dichlorobenzidine, 3,3'-	91-94-1	NC	NC	NC	NC	1	0.54		1
DDD	72-54-8	1	0.2	1	0.2	1	0.2	1	1
DDE	72-55-9	1	0.2	1	0.2	1	0.2	1	1
DDT	50-29-3	1	0.2	1	0.2	1	0.2	1	1
Dichloroethane, 1,1-	75-34-3	1.3	0.13	1.3	0.13	NC	NC	1	

Dichloroethane, 1,2-	107-06-2	1	0.1	1	0.1	1	0.1	1	1
Dichloroethylene, 1,1-	75-35-4	1	0.1	1	0.1			1	
Dichloroethylene, cis-1,2-	156-59-2	1	0.1	1	0.1	NC	NC	1	
Dichloroethylene, trans-1,2-	156-60-5	1	0.1	1	0.1	NC	NC	1	
Dichloromethane	75-09-2	1	0.1	1	0.1	1	0.1	1	1
Dichlorophenol, 2,4-	120-83-2	1	0.4	1	0.4	NC	NC	1	
Dichloropropane, 1,2-	78-87-5	NC	NC	NC	NC	1	0.2	1	1
Dichloropropene, 1,3-	542-75-6	1	0.2	1	0.2	1	0.2	1	1
Dieldrin	60-57-1	1	0.25	1	0.25	1	0.25	1	1
Diethyl phthalate	84-66-2	1	0.07	1	0.07	NC	NC	1	
Dimethyl phthalate	131-11-3	1	0.07	1	0.07	NC	NC	1	
Dimethylphenol, 2,4-	105-67-9	1	0.26	1	0.26	NC	NC	1	
Dinitrophenol, 2,4-	51-28-5	1	0.26	1	0.26	NC	NC	1	
Dinitrotoluene, 2,4-	121-14-2	1	0.13	1	0.13	1	0.13	1	1
Dioxane, 1,4-	123-91-1	1	0.25	1	0.25	1	0.25	1	1
Endosulfan	115-29-7	1	0.2	1	0.2	NC	NC	1	
Endrin	72-20-8	1	0.25	1	0.25	NC	NC	1	
Ethylbenzene	100-41-4	1	0.2	1	0.2	NC	NC	1	
Ethylene dibromide	106-93-4	1	0.1	1	0.1	1	0.1	1	1
Fluoranthene	206-44-0	0.36	0.1	0.36	0.1	NC	NC	1	
Fluorene	86-73-7	0.36	0.1	0.36	0.1	NC	NC	1	
Heptachlor	76-44-8	1	0.2	1	0.2	1	0.2	1	1
Heptachlor epoxide	1024-57-3	1	0.2	1	0.2	1	0.2	1	1
Hexachlorobenzene	118-74-1	1	0.13	1	0.13	1	0.13	1	1
Hexachlorobutadiene	87-68-3	1	0.2	1	0.2	1	0.2	1	1
gamma-HCH	58-89-9	1	0.2	1	0.2	1	0.2	1	1
Hexachloroethane	67-72-1	1	1	1	1	1	1	1	1
Hmx	2691-41-0	1	0.2	1	0.2	NC	NC	1	
Indeno(1,2,3-cd)pyrene	193-39-5	0.28	0.02	0.28	0.02	0.28	0.02	1	1
Lead	7439-92-1	0.5	0.006	0.5	0.006	NC	NC	1	
Mercury	7439-97-6	1	0.05	1	0.05	NC	NC	1	
Methoxychlor	72-43-5	1	0.2	1	0.2	NC	NC	1	
Methyl ethyl ketone	78-93-3	1	0.1	1	0.1	NC	NC	1	
Methyl isobutyl ketone	108-10-1	1	0.1	1	0.1	NC	NC	1	
Methyl mercury	22967-92-6	1	0.2	1	0.2	NC	NC	1	
Methyl tert butyl ether	1634-04-4	1	0.1	1	0.1	NC	NC	1	
Methylnaphthalene, 2-	91-57-6	0.36	0.1	0.36	0.1	NC	NC	1	
Naphthalene	91-20-3	0.36	0.1	0.36	0.1	NC	NC	1	
Nickel	7440-02-0	1	0.35	1	0.35	NC	NC	1	1
N-nitrosodimethylamine (NDMA)	62-75-9					1	0.2		1
Pentachlorophenol	87-86-5	1	0.11	1	0.11	1	0.11	1	1
Perchlorate	NA	1	0.2	1	0.2			1	
Petroleum hydrocarbons	NA								
Aliphatics C5 to C8	NA	1	1	1	1	NC	NC	1	
Aliphatics C9 to C12	NA	1	0.5	1	0.5	NC	NC	1	
Aliphatics C9 to C18	NA	1	0.5	1	0.5	NC	NC	1	
Aliphatics C19 to C36	NA	1	0.1	1	0.1	NC	NC		
Aromatics C9 to C10	NA	1	0.5	1	0.5	NC	NC	1	
Aromatics C11 to C22	NA	0.36	0.1	0.36	0.1	NC	NC	1	
Phenanthrene	85-01-8	0.36	0.1	0.36	0.1	NC	NC	1	

Phenol	108-95-2	1	0.26	1	0.26	NC	NC	1	
Polychlorinated biphenyls (PCBs)	1336-36-3	0.85	0.16	0.85	0.16	0.85	0.16	1	1
Pyrene	129-00-0	0.36	0.1	0.36	0.1	NC	NC	1	
Rdx	121-82-4	1	0.2	1	0.2	1	0.2	1	1
Selenium	7782-49-2	1	0.002	1	0.002	NC	NC	1	
Silver	7440-22-4	1	0.25	1	0.25	NC	NC	1	
Styrene	100-42-5	1	0.2	1	0.2	1	0.2	1	1
TCDD, 2,3,7,8- (equivalents)	1746-01-6	NC	NC	NC	NC	1	0.2		1
Tetrachloroethane, 1,1,1,2-	630-20-6	1	1.4	1	1.4	1	1.4	1	1
Tetrachloroethane, 1,1,2,2-	79-34-5	NC	NC	NC	NC	1	1.4	1	1
Tetrachloroethylene	127-18-4	1	0.1	1	0.1	1	0.1	1	1
Thallium	7440-28-0	1	0.01	1	0.01	NC	NC	1	
Toluene	108-88-3	1	0.12	1	0.12	NC	NC	1	
Trichlorobenzene, 1,2,4-	120-82-1	1	0.08	1	0.08	NC	NC	1	
Trichloroethane, 1,1,1-	71-55-6	1	0.1	1	0.1	NC	NC	1	
Trichloroethane, 1,1,2-	79-00-5	1	1	1	1	1	1	1	1
Trichloroethylene	79-01-6	1	0.1	1	0.1	1	0.1	1	1
Trichlorophenol, 2,4,5-	95-95-4	1	0.26	1	0.26	NC	NC	1	
Trichlorophenol 2,4,6-	88-06-2	NC	NC	NC	NC	1	0.26		1
Vanadium	7440-62-2	1	0.03	1	0.03	NC	NC	1	
Vinyl chloride	75-01-4	1	0.1	1	0.1	1.53	0.16	1	1
Xylenes (mixed isomers)	1330-20-7	1	0.12	1	0.12	NC	NC	1	
Zinc	7440-66-6	1	0.02	1	0.02	NC	NC	1	
zzTriMethylbenzene, 1,3,5-	108-67-8	1	1	1	1	1	1	1	1
zzzTriMethylbenzene, 1,2,4-	95-63-6	1	1	1	1	1	1	1	1
zzzzButylbenzene	104-51-8	1	1	1	1	1	1	1	1

1: Default values. If there is no Reference Concentration, a non-caneer inhalation RAF was not implied. If there is no Inhalation Unit Risk, a caneer inhalation RAF was n

OIL OR HAZARDOUS MATERIAL	CAS	Relative Absorption Factors (RAFs) Water Subchronic Ingestion	Water Chronic Ingestion	Water Cancer Ingestion	Produce Noncancer Ingestion	Produce Cancer Ingestion	Oral Absorption Efficiency Tox Study OAEnoncance	Oral Absorption Efficiency Tox Study OAEcancer	Outside Effective Predictive Domain	Fraction Absorbed[1] FA
Acenaphthene	83-32-9	1	1				0.92	NC		1
Acenaphthylene	208-96-8	0.91	0.91				0.92	NC	*	1
Acetone	67-64-1	1	1				1	NC		1
Aldrin	309-00-2	1	1	1			0.8	0.8		1
Anthracene	120-12-7	1	1				0.92	NC	*	1
Antimony	7440-36-0	1	1				0.1	NC		1
Arsenic	7440-38-2	1	1	1	1	1	0.98	0.98		1
Barium	7440-39-3	1	1				0.91	NC		1
Benzene	71-43-2	1	1	1			1	1		1
Benzo(a)anthracene	56-55-3	0.91	0.91	1			0.92	0.92	*	1
Benzo(a)pyrene	50-32-8	0.91	0.91	1			0.92	0.92	*	1
Benzo(b)fluoranthene	205-99-2	0.91	0.91	1			0.92	0.92	*	1
Benzo(g,h,i)perylene	191-24-2	0.91	0.91				0.92	NC	*	1
Benzo(k)fluoranthene	207-08-9	0.91	0.91	1			0.92	0.92	*	1
Beryllium	7440-41-7	1	1	1			0.01	0.01		1
Biphenyl, 1,1-	92-52-4	1	1				1	NC		1
Bis(2-chloroethyl)ether	111-44-4			1				0.98		1
Bis(2-chloroisopropyl)ether	39638-32-9	1	1	1			0.98	0.98		1
Bis(2-ethylhexyl)phthalate	117-81-7	1	1	1			1	1	*	0.8
Bromodichloromethane	75-27-4	1	1	1			0.98	0.98		1
Bromoform	75-25-2	1	1	1			0.9	0.9		1
Bromomethane	74-83-9	1	1				0.97	NC		1
Cadmium	7440-43-9	1	1		1		0.07	NC		1
Carbon tetrachloride	56-23-5	1	1	1			1	1		1
Chlordane	12789-03-6	1	1	1	0.91	1	0.8	0.8	*	0.7
Chloroaniline, p-	106-47-8	1	1				1	NC		1
Chlorobenzene	108-90-7	1	1				1	NC		1
Chloroform	67-66-3	1	1				1	1		1
Chlorophenol, 2-	95-57-8	1	1				1	NC		1
Chromium (total)	7440-47-3	1	1		1		0.11	NC		1
Chromium(III)	16065-83-1	1	1		1		0.25	NC		1
Chromium(VI)	18540-29-9	1	1		1		0.11	NC		1
Chrysene	218-01-9	0.91	0.91	1			0.92	0.92	*	1
Cyanide	57-12-5	1	1				1	NC		1

Dibenzo(a,h)anthracene	53-70-3	0.91	0.91	1		0.92	0.92	*	0.6
Dibromochloromethane	124-48-1	1	1	1		0.98	0.98		1
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	1	1			1	NC		1
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	1	1			1	NC		1
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	1	1	1		1	1		1
Dichlorobenzidine, 3,3'-	91-94-1		1	1		0.9	0.9		1
DDD	72-54-8	1	1	1		0.9	0.6	*	0.8
DDE	72-55-9	1	1	1		0.9	0.6	*	0.8
DDT	50-29-3	1	1	1		0.9	0.6	*	0.7
Dichloroethane, 1,1-	75-34-3	1.3	1.3			0.75	NC		1
Dichloroethane, 1,2-	107-06-2	1	1	1		1	1		1
Dichloroethylene, 1,1-	75-35-4	1	1			1	0.98		1
Dichloroethylene, cis-1,2-	156-59-2	1	1			0.84	NC		1
Dichloroethylene, trans-1,2-	156-60-5	1	1			0.84	NC		1
Dichloromethane	75-09-2	1	1	1		1	1		1
Dichlorophenol, 2,4-	120-83-2	1	1			1	NC		1
Dichloropropane, 1,2-	78-87-5			1		1	1		1
Dichloropropene, 1,3-	542-75-6	1	1	1		1	1		1
Dieldrin	60-57-1	1	1	1		0.8	0.8	*	0.8
Diethyl phthalate	84-66-2	1	1			1	NC		1
Dimethyl phthalate	131-11-3	1	1			1	NC		1
Dimethylphenol, 2,4-	105-67-9	1	1			1	NC		1
Dinitrophenol, 2,4-	51-28-5	1	1			1	NC		1
Dinitrotoluene, 2,4-	121-14-2	1	1	1		0.9	0.9		1
Dioxane, 1,4-	123-91-1	1	1	1		1	1		1
Endosulfan	115-29-7	1	1			1	NC	*	1
Endrin	72-20-8	1	1			0.8	NC	*	0.8
Ethylbenzene	100-41-4	1	1			1	NC		1
Ethylene dibromide	106-93-4	1	1	1		1	1		1
Fluoranthene	206-44-0	1	1			0.92	NC	*	1
Fluorene	86-73-7	1	1			0.92	NC	*	1
Heptachlor	76-44-8	1	1	1		0.66	0.66	*	0.8
Heptachlor epoxide	1024-57-3	1	1	1		0.66	0.66	*	1
Hexachlorobenzene	118-74-1	1	1	1		0.8	0.8	*	0.9
Hexachlorobutadiene	87-68-3	1	1	1		1	1	*	0.9
gamma-HCH	58-89-9	1	1	1		1	1		0.9
Hexachloroethane	67-72-1	1	1	1		1	1		1
Hmx	2691-41-0	1	1			0.3	NC		1
Indeno(1,2,3-cd)pyrene	193-39-5	0.91	0.91	1		0.92	0.92	*	0.6
Lead	7439-92-1	0.5	0.5		0.5	0.5	NC		1

Mercury	7439-97-6	1	1				0.95	NC		1
Methoxychlor	72-43-5	1	1				1	NC	*	1
Methyl ethyl ketone	78-93-3	1	1				1	NC		1
Methyl isobutyl ketone	108-10-1	1	1				1	NC		1
Methyl mercury	22967-92-6	1	1				0.95	NC		1
Methyl tert butyl ether	1634-04-4	1	1				1			1
Methylnaphthalene, 2-	91-57-6	1	1				0.92	NC		1
Naphthalene	91-20-3	1	1				0.92	NC		1
Nickel	7440-02-0	1	1			1	0.1	NC		1
N-nitrosodimethylamine (NDMA)	62-75-9			1				1		1
Pentachlorophenol	87-86-5	1	1		1		0.9	0.9	*	0.9
Perchlorate	NA	1	1			1	1			1
Petroleum hydrocarbons	NA									
Aliphatics C5 to C8	NA	1	1				1	NC		1
Aliphatics C9 to C12	NA	1	1				1	NC	*	1
Aliphatics C9 to C18	NA	1	1				1	NC	*	1
Aliphatics C19 to C36	NA	1	1				1	NC	*	1
Aromatics C9 to C10	NA	0.91	0.91				0.92	NC		1
Aromatics C11 to C22	NA	0.91	0.91				0.92	NC	*	1
Phenanthrene	85-01-8	0.91	0.91				0.92	NC	*	1
Phenol	108-95-2	1	1				1	NC		1
Polychlorinated biphenyls (PCBs)	1336-36-3	1	1	1	1	1	0.89	0.89	*	0.5
Pyrene	129-00-0	1	1				0.92	NC	*	1
Rdx	121-82-4	1	1	1			1	1		1
Selenium	7782-49-2	1	1				0.6	NC		1
Silver	7440-22-4	1	1				0.04	NC		1
Styrene	100-42-5	1	1	1			1	1		1
TCDD, 2,3,7,8- (equivalents)	1746-01-6			1			1	1	*	0.5
Tetrachloroethane, 1,1,1,2-	630-20-6	1	1	1			0.7	0.7		1
Tetrachloroethane, 1,1,2,2-	79-34-5			1				0.7		1
Tetrachloroethylene	127-18-4	1	1	1			1	1		1
Thallium	7440-28-0	1	1				1	NC		1
Toluene	108-88-3	1	1				1	NC		1
Trichlorobenzene, 1,2,4-	120-82-1	1	1				1	NC		1
Trichloroethane, 1,1,1-	71-55-6	1	1				1	NC		1
Trichloroethane, 1,1,2-	79-00-5	1	1	1			1	1		1
Trichloroethylene	79-01-6	1	1	1			1	1		1
Trichlorophenol, 2,4,5-	95-95-4	1	1				1	NC		1
Trichlorophenol 2,4,6-	88-06-2			1			1	1		1
Vanadium	7440-62-2	1	1				0.05	NC		1

Vinyl chloride	75-01-4	1	1	1.53			0.98	0.64			1
Xylenes (mixed isomers)	1330-20-7	1	1				1	NC			1
Zinc	7440-66-6	1	1		1		0.46	NC			1
zzTriMethylbenzene, 1,3,5-	108-67-8	1	1	1		1	1		1		1
zzzTriMethylbenzene, 1,2,4-	95-63-6	1	1	1		1	1		1		1
zzzzButylbenzene	104-51-8	1	1	1	1		1	1			1

[1] U.S. EPA (2001) Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim (http://www.epa.gov/superfund/programs/risk/ragse/). Appendix B (Exhibit B-3).

OIL OR HAZARDOUS MATERIAL		Molecular Weight g/mole	log K_{ow}	Permeability Coefficient Kp[1] cm/hr	Henry's Law Constant HLC atm-m3/mol	Metal	Plant Uptake Factor Ksp mg-soil/mg-plant	Outside Effective Predictive Domain	Diffusivity in air, Da (cm^2/s)	REF	Diffusivity in water, Dw (cm^2/s)	REF
Acenaphthene	83-32-9	154	3.92	8.410E-02	1.84E-04				4.21E-02	6	7.69E-06	6
Acenaphthylene	208-96-8	154	4.07	1.056E-01	1.14E-04			*	4.39E-02	47	7.07E-06	48
Acetone	67-64-1	58	-0.24	5.210E-04	3.97E-05				1.24E-01	6	1.14E-05	6
Aldrin	309-00-2	365	3.01	1.389E-03	4.40E-05				1.32E-02	6	4.86E-06	6
Anthracene	120-12-7	178	4.55	1.608E-01	5.56E-05			*	3.24E-02	6	7.74E-06	6
Antimony	7440-36-0	122		1.000E-03		yes						
Arsenic	7440-38-2	75		1.000E-03		yes	0.05					
Barium	7440-39-3	137		1.000E-03		yes						
Benzene	71-43-2	78	2.13	1.476E-02	5.55E-03				8.80E-02	6	9.80E-06	6
Benzo(a)anthracene	56-55-3	228	5.66	4.558E-01	1.20E-05			*	5.10E-02	6	9.00E-06	6
Benzo(a)pyrene	50-32-8	252	6.1	6.528E-01	4.57E-07			*	4.30E-02	6	9.00E-06	6
Benzo(b)fluoranthene	205-99-2	252	6.12	6.730E-01	6.57E-07			*	2.26E-02	6	5.56E-06	6
Benzo(g,h,i)perylene	191-24-2	276	6.51	8.933E-01	3.31E-07			*	4.90E-02	47	5.65E-05	48
Benzo(k)fluoranthene	207-08-9	252	6.06	6.143E-01	5.84E-07			*	2.26E-02	6	5.56E-06	6
Beryllium	7440-41-7	9		1.000E-03		yes						
Biphenyl, 1,1-	92-52-4	154	4.09	1.089E-01	3.08E-04				5.73E-02	47	6.71E-06	48
Bis(2-chloroethyl)ether	111-44-4	143	1.29	1.781E-03	1.70E-05				6.92E-02	47	7.53E-06	48
Bis(2-chloroisopropyl)ether	39638-32-9	171	2.1	4.250E-03	3.32E-04				6.00E-02	6	6.40E-06	6
Bis(2-ethylhexyl)phthalate	117-81-7	391	5.11	2.415E-02	2.70E-07			*	3.51E-02	6	3.66E-06	6
Bromodichloromethane	75-27-4	164	2.09	4.581E-03	2.12E-03				2.98E-02	6	1.06E-05	6
Bromoform	75-25-2	253	2.37	2.225E-03	5.35E-04				1.49E-02	6	1.03E-05	6
Bromomethane	74-83-9	95			7.34E-03				7.28E-02	6	1.21E-05	6
Cadmium	7440-43-9	112		1.000E-03		yes	1.9					
Carbon tetrachloride	56-23-5	154	2.83	1.605E-02	2.76E-02				7.80E-02	6	8.80E-06	6
Chlordane	12789-03-6	410	5.54	3.634E-02	7.03E-05		11	*	1.18E-02	6	4.37E-06	6
Chloroaniline, p-	106-47-8	128	1.85	5.061E-03	1.16E-06				4.83E-02	6	1.01E-05	6
Chlorobenzene	108-90-7	113	2.84	2.764E-02	3.11E-03				7.30E-02	6	8.70E-06	6
Chloroform	67-66-3	119	1.97	6.820E-03	3.67E-03				1.04E-01	6	1.00E-05	6
Chlorophenol, 2-	95-57-8	129	2.16	8.002E-03	1.12E-05				5.01E-02	6	9.46E-06	6
Chromium (total)	7440-47-3	52		2.000E-03		yes	0.095					
Chromium(III)	16065-83-1	52		1.000E-03		yes	0.095					
Chromium(VI)	18540-29-9	52		2.000E-03		yes	0.095					
Chrysene	218-01-9	228	5.66	4.558E-01	5.23E-06			*	2.48E-02	6	6.21E-06	6
Cyanide	57-12-5	27		1.000E-03	2.42E-02	yes						
Dibenzo(a,h)anthracene	53-70-3	278	6.84	1.437E+00	1.23E-07			*	2.02E-02	6	5.18E-06	6
Dibromochloromethane	124-48-1	208	2.17	2.934E-03	7.83E-04				1.96E-02	6	1.05E-05	6
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	147	3.38	4.051E-02	1.92E-03				6.90E-02	6	7.90E-06	6
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	147	3.6	5.660E-02	2.63E-03				6.80E-02	6	8.13E-06	6
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	147	3.39	4.113E-02	2.41E-03				6.90E-02	6	7.90E-06	6
Dichlorobenzidine, 3,3'-	91-94-1	253	3.51	1.258E-02	2.84E-11				1.94E-02	6	6.74E-06	6
DDD	72-54-8	320	5.8	1.722E-01	6.60E-06			*	1.69E-02	6	4.76E-06	6
DDE	72-55-9	318	5.69	1.495E-01	4.16E-05			*	1.44E-02	6	5.87E-06	6

DDT	50-29-3	354	6.36	2.601E-01	8.32E-06			*	1.37E-02	6	4.95E-06	6
Dichloroethane, 1,1-	75-34-3	99	1.79	6.714E-03	5.62E-03				7.42E-02	6	1.05E-05	6
Dichloroethane, 1,2-	107-06-2	99	1.48	4.192E-03	1.18E-03				1.04E-01	6	9.90E-06	6
Dichloroethylene, 1,1-	75-35-4	97	2.13	1.155E-02	2.61E-02				9.00E-02	6	1.04E-05	6
Dichloroethylene, cis-1,2-	156-59-2	97	1.86	7.663E-03	4.08E-03				7.36E-02	6	1.13E-05	6
Dichloroethylene, trans-1,2-	156-60-5	97	1.86	7.663E-03	9.38E-03				7.07E-02	6	1.19E-05	6
Dichloromethane	75-09-2	85	1.25	3.540E-03	3.25E-03				1.01E-01	6	1.17E-05	6
Dichlorophenol, 2,4-	120-83-2	163	2.92	1.638E-02	5.51E-06				3.46E-02	6	8.77E-06	6
Dichloropropane, 1,2-	78-87-5	113	2	7.713E-03	2.82E-03				7.82E-02	6	8.73E-06	6
Dichloropropene, 1,3-	542-75-6	111	1.6	4.309E-03	3.55E-03				6.26E-02	6	1.00E-05	6
Dieldrin	60-57-1	381	4.56	1.191E-02	1.00E-05			*	1.25E-02	6	4.74E-06	6
Diethyl phthalate	84-66-2	222	2.47	3.864E-03	6.10E-07				2.56E-02	6	6.35E-06	6
Dimethyl phthalate	131-11-3	194	1.56	1.391E-03	1.97E-07				5.68E-02	47	6.30E-06	48
Dimethylphenol, 2,4-	105-67-9	122	2.3	1.083E-02	9.51E-07				5.84E-02	6	8.69E-06	6
Dinitrophenol, 2,4-	51-28-5	184	1.55	1.558E-03	8.60E-08				2.73E-02	6	9.06E-06	6
Dinitrotoluene, 2,4-	121-14-2	182	1.98	3.073E-03	5.40E-08				2.03E-01	6	7.06E-06	6
Dioxane, 1,4-	123-91-1	88	-0.32	3.133E-04	4.80E-06				2.30E-01	47	1.00E-05	48
Endosulfan	115-29-7	407	4.1	4.234E-03	6.50E-05			*	1.15E-02	6	4.55E-06	6
Endrin	72-20-8	381	4.56	1.191E-02	6.36E-06			*	1.25E-02	6	4.74E-06	6
Ethylbenzene	100-41-4	106	3.15	4.846E-02	7.88E-03				7.50E-02	6	7.80E-06	6
Ethylene dibromide	106-93-4	188	1.96	2.759E-03	6.50E-04				2.17E-02	47	1.90E-05	48
Fluoranthene	206-44-0	202	4.95	2.167E-01	8.86E-06			*	3.02E-02	6	6.35E-06	6
Fluorene	86-73-7	166	4.21	1.119E-01	9.62E-05			*	3.63E-02	6	7.88E-06	6
Heptachlor	76-44-8	374	4.27	8.391E-03	2.94E-04			*	1.12E-02	6	5.69E-06	6
Heptachlor epoxide	1024-57-3	389	5	2.097E-02	2.10E-05			*	1.32E-02	6	4.23E-06	6
Hexachlorobenzene	118-74-1	285	5.31	1.284E-01	1.70E-03			*	5.42E-02	6	5.91E-06	6
Hexachlorobutadiene	87-68-3	261	4.78	7.820E-02	1.03E-02			*	5.61E-02	6	6.16E-06	6
gamma-HCH	58-89-9	291	3.73	1.077E-02	5.14E-06				1.42E-02	6	7.34E-06	6
Hexachloroethane	67-72-1	237	3.93	2.928E-02	3.89E-03				2.50E-03	6	6.80E-06	6
Hmx	2691-41-0	296.2	0.26	5.163E-05	8.67E-10				4.30E-02	47	4.95E-06	48
Indeno(1,2,3-cd)pyrene	193-39-5	276	6.58	9.936E-01	3.48E-07			*	1.90E-02	6	5.66E-06	6
Lead	7439-92-1	207		1.000E-04		yes	0.15					
Mercury	7439-97-6	201		1.000E-03		yes			3.07E-02	6	6.30E-06	6
Methoxychlor	72-43-5	346	5.08	4.123E-02	2.03E-07			*	1.56E-02	6	4.46E-06	6
Methyl ethyl ketone	78-93-3	72	0.29	9.732E-04	5.69E-05				8.08E-02	47	9.80E-06	48
Methyl isobutyl ketone	108-10-1	100	1.19	2.663E-03	1.38E-04				7.50E-02	47	7.80E-06	48
Methyl mercury	22967-92-6	231		1.000E-03		yes			5.30E-02	47	6.10E-06	48
Methyl tert butyl ether	1634-04-4	88	1.05	2.513E-03	5.87E-04				2.37E-03	47	8.63E-06	48
Methylnaphthalene, 2-	91-57-6	142	3.86	8.962E-02	5.18E-04				6.29E-02	47	7.20E-06	48
Naphthalene	91-20-3	128	3.3	4.584E-02	4.40E-04				5.90E-02	6	7.50E-06	6
Nickel	7440-02-0	59		2.000E-04		yes	0.38					
N-nitrosodimethylamine (NDMA)	62-75-9	74.0822	-0.57	2.564E-04	1.82E-06				1.13E-01	44	1.24E-05	44
Pentachlorophenol	87-86-5	266	5.86	3.784E-01	2.45E-08			*	5.60E-02	6	6.10E-06	6
Perchlorate	NA			0.000E+00								
Petroleum hydrocarbons	NA											
Aliphatics C5 to C8	NA	93	3.85	1.660E-01	1.296				8.00E-02		1.00E-06	6
Aliphatics C9 to C12	NA	149	5.52	1.020E+00	1.56			*	7.00E-02		1.00E-06	6

Aliphatics C9 to C18	NA	170	5.94	1.474E+00	1.656			*	7.00E-02		5.00E-06	6
Aliphatics C19 to C36	NA		11	0.000E+00				*				
Aromatics C9 to C10	NA	120	3.93	1.324E-01	0.00792				7.00E-02		1.00E-06	6
Aromatics C11 to C22	NA	150	5.09	5.241E-01	0.00072			*	6.00E-02		1.00E-06	6
Phenanthrene	85-01-8	178	4.46	1.402E-01	4.23E-05			*	3.33E-02	47	7.47E-06	48
Phenol	108-95-2	94	1.46	4.337E-03	3.33E-07				8.20E-02	6	9.10E-06	6
Polychlorinated biphenyls (PCBs)	1336-36-3	328	6.72	6.286E-01	4.15E-04		0.84	*	1.38E-02	47	4.32E-06	48
Pyrene	129-00-0	202	5.11	2.763E-01	1.19E-05			*	2.72E-02	6	7.24E-06	6
Rdx	121-82-4	222.26	0.87	3.385E-04	6.32E-08				5.20E-02	47	6.00E-06	48
Selenium	7782-49-2	79		1.000E-03		yes						
Silver	7440-22-4	108		6.000E-04		yes						
Styrene	100-42-5	104	2.95	3.669E-02	2.75E-03				7.10E-02	6	8.00E-06	6
TCDD, 2,3,7,8- (equivalents)	1746-01-6	322	6.8	7.670E-01	5.00E-05			*	4.70E-02	6	8.00E-06	6
Tetrachloroethane, 1,1,1,2-	630-20-6	168	3.03	1.816E-02	2.45E-03				7.10E-02	47	7.90E-06	48
Tetrachloroethane, 1,1,2,2-	79-34-5	168	2.39	6.864E-03	3.67E-04				7.10E-02	6	7.90E-06	6
Tetrachloroethylene	127-18-4	166	3.4	3.269E-02	1.77E-02				7.20E-02	6	8.20E-06	6
Thallium	7440-28-0	204		1.000E-03		yes						
Toluene	108-88-3	92	2.73	3.066E-02	6.64E-03				8.70E-02	6	8.60E-06	6
Trichlorobenzene, 1,2,4-	120-82-1	181	3.98	6.504E-02	1.42E-03				7.80E-02	6	8.80E-06	6
Trichloroethane, 1,1,1-	71-55-6	133	2.49	1.255E-02	1.72E-02				7.80E-02	6	8.80E-06	6
Trichloroethane, 1,1,2-	79-00-5	133	2.05	6.430E-03	8.24E-04				7.80E-02	6	8.80E-06	6
Trichloroethylene	79-01-6	131	2.42	1.158E-02	9.85E-03				7.90E-02	6	9.10E-06	6
Trichlorophenol, 2,4,5-	95-95-4	197	3.9	4.686E-02	1.62E-06				2.91E-02	6	7.03E-06	6
Trichlorophenol 2,4,6-	88-06-2	197	3.69	3.406E-02	2.60E-06				3.18E-02	6	6.25E-06	6
Vanadium	7440-62-2	51		1.000E-03		yes						
Vinyl chloride	75-01-4	63	1.36	5.556E-03	2.78E-02				1.06E-01	6	1.23E-06	6
Xylenes (mixed isomers)	1330-20-7	106	3.2	5.229E-02	6.63E-03				7.69E-02	6	8.44E-06	6
Zinc	7440-66-6	65		6.000E-04		yes	1.5					
zzTriMethylbenzene, 1,3,5-	108-67-8	120.2	3.7	9.309E-02	0.00877				0.0602254	6	7.843E-06	6
zzzTriMethylbenzene, 1,2,4-	95-63-6	120.2	3.7	9.309E-02	0.00616				0.0606754	6	7.9209E-06	6
zzzzButylbenzene	104-51-8	134.22	4.29	1.904E-01	0.0159				0.0527732	6	7.3335E-06	6

[1] U.S. EPA (2001) Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim (http://www.epa.gov/superfund/programs/risk/ragse/). Chapter 3 for metals, Appendix B (Exhibit B-2) for organics.

References used in calculating Method 3 Risk

Reference #	Description
1	U.S. EPA, Integrated Risk Information System (IRIS). On-line search: current as of January 10, 2007.
1a	The oral cancer slope factor for a mix of 2,4- and 2,6- Dinitrotoluene (from IRIS) has been used as the cancer slope factor equivalent for pure 2,4-Dinitrotoluene.
1b	The chronic oral RfD for 1,2-Dichlorobenzene has been used as the chronic oral RfD equivalent for 1,3-Dichlorobenzene and 1,4-Dichlorobenzene.
1c	IRIS lists two oral RfDs, one for food and one for water exposure. The more conservative is used here.
1d	The chronic oral RfD (from IRIS) has been used here as a subchronic oral RfD equivalent.
1e	This Cancer Slope Factor or Unit Risk for benzo(a)pyrene (from IRIS) has been applied to the seven PAH compounds which are designated as category A, B1, B2 or C carcinogens.
1f	This value (Be Oral CSF of 4.3 kg-day/mg) was recently withdrawn form IRIS, although many consultants may continue to use it, lacking any new information.
1g	The chronic oral Reference Dose for DDT has been adopted for DDD and DDE as well.
1h	The chronic RfC for Cr VI was used for CR III rather than the old, withdrawn HEAST value of 2E-6 mg/m3, which would imply that Cr III is 50 times more toxic than Cr VI.
1i	The subchronic RfD is based upon the subchronic toxicity data that is the basis of the chronic RfD presented in the IRIS file.
1j	The subchronic RfC is set equal to the chronic RfC based on information aboul subchronic toxicity presented in the IRIS file.
1k	The subchronic RfC is set equal lo a multiple (often, but not always 10) of the chronic RfC based on information about subchronic toxicity presented in the IRIS file.
2	U.S. EPA Health Effects Assessment Summary Tables (HEAST), Annual FY-1992. (OERR 9200.6-303 (92-1), NTIS No. PB92-921199) January/July 1992.
2a	This subchronic oral RfD (from HEAST) for 1,2-Dichlorobenzene has been used as the subchronic oral RfD equivalent for 1,3- and 1,4- Dichlorobenzene.
2b	The subchronlc RfC is set equal to a multiple (often, but not always 10) of the chronic RfC based on information aboul subchronic toxicity presented in HEAST.
2c	This Cancer Slope Factor or Unit Risk was taken from a fact sheet distributed by the U.S. EPA Superfund Health Risk Technical Support Center at ECAO-Cincinnati, current as of September 2, 1992.
2d	This value has been withdrawn from HEAST, although many consultants may continue to use it, lacking any new information. Consult HEAST for any additional information.
2e	from Table 2 of HEAST, calculated by an alternative method.
2f	The chronic Reference Concentration for 1,2-dichlorobenzene has been used for 1,3 dichlorobenzene.
2g	The subchronic oral RfD for DDT has been adopted for DDE and DDD as well.
3	CHEM/AAL
4	Developed for the Risk Assessment ShortForm - Residential Scenario (MA DEP, 1992) by MA DEP staff. Documentation of this value may be found in that document.
4a	This one-time allowable intake for cyanide was developed by MA DEP staff. See documentation on-line at http://www.state.ma.us/dep/ors/files/cn_soil.htm
5	This value was developed by MA DEP ORS Air/Water Toxics staff.
6	US EPA Soil Screening Guidance: Technical Background Document, EPA/540/R95/128, May 1996
6a	Measured Koc from the SSL Guidance, Table 39
6b	Calculated Koc from the SSL Guidance, Table 39
10	Owen, 1990. "Literature Derived Absorption Coefficients for 39 Chemicals via Oral and Inhalation Routes of Exposure"; Regulatory Toxicology and Pharmacology; pp. 237-252; November, 1990.
11	United States Environmental Protection Agency (USEPA), 1986. "Superfund Public Health Evaluation Manual"; U.S. Environmental Protection Agency ; Office of Emergency and Remedial Response, EPA/540/1-86/060 (OSWER Directive 9285.4-1); Washington, D.C., Oct
12	USEPA, 1992. "Dermal Exposure Assessment: Principles and Applications"; U.S. Environmental Protection Agency; Office of Research and Development, EPA/600/8-91/011B; Washington, D.C., January 1992.
13	ATSDR, "Toxicological Profile for _____"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. The ATSDR profile for the chemical of interest was used as a source of this value.
14.a. - 14.l	USEPA Test Methods for Evaluating Solid Waste, SW-846, Third Edition (Revision O), November 1986.
15.a. - 15.d.	Guide to Environmental Analytical Methods, Robert E. Wagner, editor; Genium Publishing Corporation, Schenectady, NY; 1992.
16	From CLP Statement of Work for Inorganic Analytes, 8/90, Document Number ILM01.1
17	Standard Methods for the Examination of Water and Wastewater, 17th edition; Water Environment Federation.
18	Federal Register 40 CFR 141:23:3579 (January 30, 1991).
19	USEPA Method 1613.
20	U.S. Department of Defense, 1989
21	U.S. EPA Draft Health Advisory for Methyl t-Butyl Ether, 1989.
22	Oregon Department of Environmental Quality, Development of Generic Soil Cleanup Levels Based On Analysis Of The Leachate Pathway, May 12, 1992.
23	See Appendix G: Application of SESOIL Model
24	Handbook of Environmental Data on Organic Chemicals, 2nd edition, Karel Verschueren; Van Nostrand Reinhold Co. Inc., NY; 1983. Reference #
25	Compilation of Odor and Taste Threshold Values Data, F.A. Fazzalari, editor; ASTM Data Service DS48A; 1978.

References used in calculating Method 3 Risk

Reference #	Description
27	USEPA, 1992. "Reference Guide to Odor Thresholds for Hazardous Air Pollutants Listed in the Clean Air Act Amendment of 1990", U.S. Environmental Protection Agency; Office of Research and Development, EPA/600/R-92/047; Washington, D.C., March 1992.
28	USEPA, 1992. "Indoor Air Quality Database for Organic Compounds", U.S. Environmental Protection Agency; Research Triangle Park, NC, February 1992.
29	Risk Reduction Engineering Laboratory (RREL) Treatability Database, Version 4.0.
30	U.S. Department of Defense, 1991. "Defense Priority Model Users Manual", FY 1992 version; Washington, D.C.
31	Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MassDEP VPH/EPH Approach (MassDEP, 2002) Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology (MassDEP, November 2003).
32	Chemical Health Effects Assessment Methodology and the Method to Derive Allowable Ambient Limits (CHEM/AAL). ORS Report 90-1.
33	OSHA Documentation of TLV -TWA
34	from a summary table in Tsedash Zewdie
35	Conversion of the oral Cancer Slope Factor to the inhalation Unit Risk, using the equation: Slope Factor x Ventilation Rate x Constant / Body Weight (CSF x V x C)/BW = (CSF x 20 m^3/day x 0.001 mg/µg) / 70 kg
36	From Texas NRCC document for soil standards
37	Training Workshop for Massachusetts Certified Laboratories - Handout Material - MA DEPDivision of Environmental Analysis, Wall Experiment Station (8/21/95)
38	Koc for 1,1-Biphenyl from Montgomery (Andrew Friedmann, ORS)
39	Conversion of the oral Reference Dose to a Reference Concentration, using the equation: RfD x BW / Ventilation Rate (RfD x BW) / VR = RfD x 70 kg / (20 m^3/day)
40	The Subchronic Inhalation Reference Concentration for this chemical is taken to be equal to the chronic value, absent clear chemical-specific information justifying a higher value..
41	MA DEP (2004) Perchlorate Toxicological Profile And Health Assessment. (http://www.mass.gov/dep/ors/files/chemical.htm)
42	http://chemfinder.cambridgesoft.com
43	http://esc.syrres.com
44	Toxicity value consistent with approach presented in "Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology" MA DEP 2003 and "Characterizing Risks Posed by Petroleum Contaminated Sites" MA DEP 2002.
45	Conversion of the subchronic Reference Concentration to a subchronic inhalation Reference Dose using the equation: RfC x Ventilation Rate/ Body Weight (RfC x BW) / V = (RfC x 70 kg) / 20 m^3/day
46	Conversion of the Inhalation Unit Risk Factor to an inhalation Cancer Slopoe Facotr using the equation: URF x Conversion Factor x Body Weight / Ventilation Rate (URF x CF x V) / BW = (URF x 1000 x 20 m^3/day) / 70 kg
47	Calculated according to the FSG Method presented in Chapter 17 of "The Handbook of Chemical Property Estimation Methods" by WJ Lyman, WF Reehl, and DH Rosenblatt, 1982.
48	Calculated according to the Hayduk-Laudie Method presented in Chapter 17 of "The Handbook of Chemical Property Estimation Methods" by WJ Lyman, WF Reehl, and DH Rosenblatt, 1982.
AL	Action Level in drinking water. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
MMCL	Massachusetts Maximum Contaminant Level in drinking water. 310 CMR 22. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
SMCL	Secondary Maximum Contaminant Level in drinking water. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines
NA	Not Available
NC	Not Calculated.
ORSGL	Massachusetts DEP Drinking Water Guideline developed by the Office of Research and Standards for the Drinking Water Program. See: http://www.state.ma.us/dep/brp/dws/dwspubs.htm for the current list of Massachusetts Drinking Water Standards & Guidelines

Body Weight Calculations:

Age (years)	50th Percentile Body Weight Females kg	number of years		
1<2	10.7	1		
2<3	12.7	1		
3<4	14.7	1		
4<5	16.7	1		
5<6	19	1		
6<7	21.3	1	Average	
7<8	23.8	1	1-8:	17.0 kg
8<9	27.5	1		
9<10	29.7	1		
10<11	34.5	1		
11<12	40.3	1		
12<13	45.4	1		
13<14	49	1	Average	
14<15	53.1	1	8-15:	39.9 kg
15<16	53.3	1		
16<17	55.6	1		
17<18	58.4	1		
18<25	58	7	Average	
25<31	60.9	6	15 - 30:	58.7 kg
25<35	60.9	10	Average	
35-45	63.4	10	18<45:	61.1 kg

Surface Area/Adherence Factor Calculations (S-1):

Age (years)	years	Head cm2	Face (1/3 of head) cm2	Face Soil Adherence mg/cm2	Forearms cm2	Forearms Soil Adherence mg/cm2	Hands cm2	Hands Soil Adherence mg/cm2	Lower Legs cm2	Lower Legs Soil Adherence mg/cm2	Feet cm2	Feet Soil Adherence mg/cm2	
1<2	1	855.2	282.216		305.8		274.7		481		326.5		
2<3	1	822.2	271.326		341.6		306.9		537.3		411.1		
3<4	1	882.6	291.258		467.3		395.9		697.8		467.3		
4<5	1	974.3	321.519		494.2		402.4		785.1		515.4		
5<6	1	1075	354.75		545.3		444		866.2		568.7		
6<7	1	1104.3	364.419		552.2		396.2		913.8		581.7		
7<8	1	1201.3	396.429		600.6		431		994		632.7		Adherence Factor
1<8	7	988	326	0.006	472	0.027	379	1.5	754	0.2	500	0.26	0.35
8<9	1	1310	432.3		655		470		1084		690		
9<10	1	1272	419.76		651.9		561.8		1216.9		805.6		
10<11	1	1404	463.32		719.6		620.1		1343.2		889.2		
11<12	1	1560	514.8		799.5		689		1492.4		988		
12<13	1	1223.6	403.788		959		756		1708		980		
13<14	1	1475.6	486.948		895.4		754.8		1894.4		1184		
14<15	1	1545.4	509.982		937.8		790.5		1984		1240		Adherence Factor
8<15	7	1399	462	0.0574	803	0.082	663	0.318	1532	0.0419	968	0.26	0.14
15<16	1	1249.7	412.401		949.9		800.7		2009.6		1256		
16<17	1	1273.6	420.288		1048		912		2150.4		1104		
17<18	1	1297.5	428.175		1426.3		831.3		2008.2		1189.9		
18<25	7	1110	366.3		1150		817		2180		1140		
25<31	6	1110	366.3		1150		817		2180		1140		Adherence Factor
18<31	16	1141	376	0.0574	1148	0.082	823	0.318	2157	0.0419	1148	0.2563	0.13

APPENDIX L

PUBLIC NOTIFICATION LETTERS

CLEAN PROPERTIES, INC., 111 Boston Post Road, Suite 211, Sudbury, MA 01776
Phone: 978-443-6622 Fax: 781-577-1510 Email: Public@CleanProperties.com

Clean Properties Inc.
Environmental Assessment & Cleanup

111 Boston Post Road, Suite 211
Sudbury, MA 01776
Phone: 978-443-6622
Fax: 781-577-1510
Email: public@CleanProperties.com

July 1, 2011

Hon. Joseph A. Curtatone, Mayor
City of Somerville Office of the Mayor
93 Highland Avenue
Somerville, MA 02143

Re: Partial Response Action Outcome (RAO) Statement
515 Somerville Avenue, Somerville, Massachusetts
RTN 3-23606 (ACOP-NE-09-3E009)
and
Response Action Outcome (RAO) Statements
RTN 3-28545 (ACOP-NE-09-3E009) and RTN 3-28546
and
Immediate Response Action (IRA) Completion Statements
RTN 3-28545 (ACOP-NE-09-3E009) and RTN 3-28546
and
Release Abatement Measure (RAM) Completion Statement
RTN 3-23606

Dear Mayor Curtatone:

On behalf of World 115 Nominee Trust, the owner of the above-referenced property (Property), Clean Properties, Inc., is notifying you of the availability of a RAO for the above-referenced disposal sites (RTN 3-28545, RTN 3-28546, and RTN 3-23606), pursuant to the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000.

Copies of the complete submittal can be reviewed at the Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup, Northeast Regional Office, 205B Lowell Street, Wilmington, MA 01887. Copies of the submittal also are being filed with the Public Involvement Plan (PIP) Document Repositories, including the Main Branch of the Somerville Public Library and the offices of Clean Properties, Inc., at 111 Boston Post Road, Suite 211, Sudbury, MA 01776.

A Class A-2 RAO documents the reduction of contaminant concentrations at the Sites of RTN 3-28545 and RTN 3-28546 and most of RTN 3-23606 to a Condition of No Significant Risk as demonstrated by Method 3 Risk Characterizations. A small area of RTN 3-23606 where asbestos-containing soil is isolated beneath clean cover is not covered by the current RAO. It is anticipated that closure for that approximately 1,200-square-foot area will be documented by a separate RAO within the next month.

If you have any questions, please feel free to contact us at 978-443-6622.

Very truly yours,
CLEAN PROPERTIES, INC.

Marcia J. Berger, P.E., L.S.P.
President

cc: MassDEP

Clean Properties Inc.
Environmental Assessment & Cleanup

111 Boston Post Road, Suite 211
Sudbury, MA 01776
Phone: 978-443-6622
Fax: 781-577-1510
Email: public@CleanProperties.com

July 1, 2011

Ms Paulette Renault Caragianes, Director
Somerville Health Department
50 Evergreen Avenue, City Hall Annex
Somerville, MA 02143

Re: Partial Response Action Outcome (RAO) Statement
515 Somerville Avenue, Somerville, Massachusetts
RTN 3-23606 (ACOP-NE-09-3E009)
and
Response Action Outcome (RAO) Statements
RTN 3-28545 (ACOP-NE-09-3E009) and RTN 3-28546
and
Immediate Response Action (IRA) Completion Statements
RTN 3-28545 (ACOP-NE-09-3E009) and RTN 3-28546
and
Release Abatement Measure (RAM) Completion Statement
RTN 3-23606

Dear Director Renault Caragianes:

On behalf of World 115 Nominee Trust, the owner of the above-referenced property (Property), Clean Properties, Inc., is notifying you of the availability of a RAO for the above-referenced disposal sites (RTN 3-28545, RTN 3-28546, and RTN 3-23606), pursuant to the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000.

Copies of the complete submittal can be reviewed at the Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup, Northeast Regional Office, 205B Lowell Street, Wilmington, MA 01887. Copies of the submittal also are being filed with the Public Involvement Plan (PIP) Document Repositories, including the Main Branch of the Somerville Public Library and the offices of Clean Properties, Inc., at 111 Boston Post Road, Suite 211, Sudbury, MA 01776.

A Class A-2 RAO documents the reduction of contaminant concentrations at the Sites of RTN 3-28545 and RTN 3-28546 and most of RTN 3-23606 to a Condition of No Significant Risk as demonstrated by Method 3 Risk Characterizations. A small area of RTN 3-23606 where asbestos-containing soil is isolated beneath clean cover is not covered by the current RAO. It is anticipated that closure for that approximately 1,200-square-foot area will be documented by a separate RAO within the next month.

If you have any questions, please feel free to contact us at 978-443-6622.

Very truly yours,
CLEAN PROPERTIES, INC.

Marcia J. Berger, P.E., L.S.P.
President

cc: MassDEP

Clean Properties Inc.
Environmental Assessment & Cleanup

111 Boston Post Road, Suite 211
Sudbury, MA 01776
Phone: 978-443-6622
Fax: 781-577-1510
Email: public@CleanProperties.com

July 1, 2011

Ms Monica R. Lamboy, Executive Director
Somerville Office of Strategic Planning & Community Development
93 Highland Avenue
Somerville, MA 02143

Re: Partial Response Action Outcome (RAO) Statement
515 Somerville Avenue, Somerville, Massachusetts
RTN 3-23606 (ACOP-NE-09-3E009)
and
Response Action Outcome (RAO) Statements
RTN 3-28545 (ACOP-NE-09-3E009) and RTN 3-28546
and
Immediate Response Action (IRA) Completion Statements
RTN 3-28545 (ACOP-NE-09-3E009) and RTN 3-28546
and
Release Abatement Measure (RAM) Completion Statement
RTN 3-23606

Dear Director Lamboy:

On behalf of World 115 Nominee Trust, the owner of the above-referenced property (Property), Clean Properties, Inc., is notifying you of the availability of a RAO for the above-referenced disposal sites (RTN 3-28545, RTN 3-28546, and RTN 3-23606), pursuant to the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000.

Copies of the complete submittal can be reviewed at the Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup, Northeast Regional Office, 205B Lowell Street, Wilmington, MA 01887. Copies of the submittal also are being filed with the Public Involvement Plan (PIP) Document Repositories, including the Main Branch of the Somerville Public Library and the offices of Clean Properties, Inc., at 111 Boston Post Road, Suite 211, Sudbury, MA 01776.

A Class A-2 RAO documents the reduction of contaminant concentrations at the Sites of RTN 3-28545 and RTN 3-28546 and most of RTN 3-23606 to a Condition of No Significant Risk as demonstrated by Method 3 Risk Characterizations. A small area of RTN 3-23606 where asbestos-containing soil is isolated beneath clean cover is not covered by the current RAO. It is anticipated that closure for that approximately 1,200-square-foot area will be documented by a separate RAO within the next month.

If you have any questions, please feel free to contact us at 978-443-6622.

Very truly yours,
CLEAN PROPERTIES, INC.

Marcia J. Berger, P.E., L.S.P.
President

cc: MassDEP

Clean Properties Inc.
Environmental Assessment & Cleanup

111 Boston Post Road, Suite 211
Sudbury, MA 01776
Phone: 978-443-6622
Fax: 781-577-1510
Email: public@CleanProperties.com

July 1, 2011

Distribution List
Public Involvement Plan (PIP)

Re: Partial Response Action Outcome (RAO) Statement
515 Somerville Avenue, Somerville, Massachusetts
RTN 3-23606 (ACOP-NE-09-3E009)
and
Response Action Outcome (RAO) Statements
RTN 3-28545 (ACOP-NE-09-3E009) and RTN 3-28546
and
Immediate Response Action (IRA) Completion Statements
RTN 3-28545 (ACOP-NE-09-3E009) and 3-28546
and
Release Abatement Measure (RAM) Completion Statement
RTN 3-23606 (ACOP-NE-09-3E009)

Dear PIP Members:

On behalf of World 115 Nominee Trust, the owner of the above-referenced property (Property), Clean Properties, Inc., is notifying you of the availability of a RAO for the above-referenced disposal sites (RTN 3-28545, RTN 3-28546, and RTN 3-23606), pursuant to the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000.

Copies of the complete submittal can be reviewed at the Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup, Northeast Regional Office, 205B Lowell Street, Wilmington, MA 01887. Copies of the submittal also are being filed with the Public Involvement Plan (PIP) Document Repositories, including the Main Branch of the Somerville Public Library and the offices of Clean Properties, Inc., at 111 Boston Post Road, Suite 211, Sudbury, MA 01776.

A Class A-2 RAO documents the reduction of contaminant concentrations at the Sites of RTN 3-28545 and RTN 3-28546 and most of RTN 3-23606 to a Condition of No Significant Risk as demonstrated by Method 3 Risk Characterizations. A small area of RTN 3-23606 where asbestos-containing soil is isolated beneath clean cover is not covered by the current RAO. It is anticipated that closure for that approximately 1,200-square-foot area will be documented by a separate RAO within the next month.

If you have any questions, please feel free to contact us at 978-443-6622.

Very truly yours,
CLEAN PROPERTIES, INC.

Marcia J. Berger, P.E., L.S.P.
President

cc: MassDEP